Railway Mechanical Engineer

Vol. 102 JULY, 1928 No. 7

Contents

Attempts to increase steam locomotive efficiency ..... Page 384

The first of a series of two articles by A. I. Lipetz, consulting engineer, American Locomotive Company, reviewing the progress that has been attained in locomotive development.

The spot system of repairing freight cars ..... Page 396

A description of the uniform procedure of repairing freight cars on the Baltimore & Ohio that has been in effect since 1920.

Highball Scott, catalogue expert ..... Page 405

In which two of the gentlemen whom you met last month frankly discuss catalogues in general.

EDITORIALS:

Do you budget your spare time? 369
A wholesome trend in standardization 369
"Breaking grooves" in car structures 369
Attempts to increase locomotive efficiency 369
Smoke—An unpopular topic 370
Help reduce arbitration cases 370
Engine truck lubrication 370
How to get terminal improvements 371
New Books 371

GENERAL:

Modified Mountain locomotive for the Santa Fe 373
The locomotive as a factor in fuel economy* 380
Grease cup cap for running repairs 383
Attempts to increase steam locomotive efficiency ... 384
Something new in Walschaert valve gear 391

CAR DEPARTMENT:

Car and operating department co-operation 392
Small dolly cars save labor 395
The spot system of repairing freight cars 396
Chicago & Illinois Midland gondola 400
Decisions of the Arbitration Committee 401
A centering device for the wheel shop 402
Improvised tank for heating tar 403
Jack truck for applying draft gears 403

SHOP PRACTICE:

Device for pulling in valve bushings 404
Counterborer with a removable tool 404
Highball Scott, catalogue expert 405
Spring plant of the Baltimore & Ohio at Mt. Clare shops 409

THE READER'S PAGE:

Freight car maintenance 414
Interpretation 25 of Rule 17 414
An antique tool still survives 414

NEW DEVICES:

Monarch heavy duty lathe 415
A gasoline industrial tractor with a 10-ft. boom 416
A blue fresnel for the car repairman's lantern 417
Brake cylinder protector 417

NEWS OF THE MONTH 418

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY
34 North Crystal Street, East Stroudsburg, Pa.
Executive offices: 30 Church Street, New York

EDWARD A. SIMMONS, *President* HENRY LEE, *Vice-Pres. & Treas.*
L. B. SHERMAN, *Vice-President* SAMUEL O. DUNN, *Vice-President*
CECIL R. MILLS, *Vice-President* ROY V. WRIGHT, *Secretary*
30 Church Street, New York, N. Y.
F. H. THOMPSON, *Vice-President and Business Manager, Cleveland*

Chicago: 105 West Adams St. Cleveland: 6007 Euclid Ave.
Washington: 17th and H Sts., N. W.
San Francisco: 215 Market St.

ROY. V. WRIGHT, *Editor*
C. B. PECK, *Managing Editor*
MARION B. RICHARDSON, *Associate Editor* L. R. GURLEY, *Associate Editor*
E. L. WOODWARD, *Western Editor*, Chicago
H. C. WILCOX, *Associate Editor*, Cleveland, Ohio

Request for change of address should reach the New York office two weeks before the date of the issue with which it is to go into effect. It is difficult and often impossible to supply back numbers to replace those undelivered through failure to send advance notice. In sending us change of address, be sure to send us your old address as well as the new one.

Subscriptions, including the eight daily editions of the Railway Age published in June, in connection with the annual convention of the American Railway Association, Mechanical Division, payable in advance and postage free: United States, Canada and Mexico, $3.00 a year; foreign countries, not including daily editions of the Railway Age, $4.00.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

More Timken Cars
for the Milwaukee Road
The Chicago, Milwaukee, St. Paul and Pacific has just placed a repeat order for ten Pullman cars, two dining cars and two club cars—all on Timken Bearings. This makes a total of 161 Timken-equipped cars on the Milwaukee Road, including 72 Timken-equipped Pullman sleeping cars.
THE TIMKEN ROLLER BEARING CO., CANTON, OHIO
TIMKEN
Tapered
ROLLER BEARINGS

and now 10 more!

Swiftly following the above recent announcement of the Milwaukee Road's repeat order for Timken-equipped cars, this railroad repeats again.

Now ten new Timken-equipped baggage cars make a total of 171 Timken-equipped cars—including 72 Pullman sleepers—on the Chicago, Milwaukee, St. Paul & Pacific.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

Railway Mechanical Engineer

Vol. 102 July, 1928 No. 7

Do you budget your spare time?

The minutes of foremen's staff meetings always afford an excellent agency for the department head to put across many ideas and suggestions in a way that could not be done as well otherwise. The following statement, extracted from the minutes of a recent car department staff meeting, immediately followed the budget figures for the ensuing month chargeable to accounts 314, freight train car repairs, 317, passenger train car repairs and 326, work equipment repairs, with which all car department foremen are familiar: "The necessity of having our expenses beneath these allotments is very important and we cannot, under any consideration extend these allowances. We have talked a great deal about budgeting our expense. Did it ever occur to each one of you how much could be accomplished if you were to budget your spare time and use a certain proportion of it for advancing yourself in your chosen line of work? Think it over."

A wholesome trend in standardization

A significant feature of the report of the Committee on Car Construction of the Mechanical Division, American Railway Association, presented at the Atlantic City convention last month, is the trend away from complete standardization of cast steel truck side frames and toward a standardization of essential dimensions so that any design conforming to these dimensions, and to the A.R.A. specifications for strength, may be considered as standard. As the committee stated in its report, its action in this respect was taken as the result of the active development in truck side frame design which has taken place during the past year. The need for further development in the details of truck design continues, and the breadth of vision of the committee is even more strikingly indicated by the following note which appears on the diagram describing axle spacing, clearance and other dimensions which it is desirable to keep standard: "Alternate designs involving non-standard bolster, spring plank, or spring arrangement will be permissible provided that they conform to A.R.A. specifications for strength and the truck as a whole meets A.R.A. requirements for interchangeability". This complete recognition of the several types of trucks with special bolster and spring arrangements, as well as of the possibilities for improvement in the distribution of the metal in the side frame itself, will, undoubtedly, encourage the intensive application of designing talent to the development of further improvements in the reliability and functioning of freight car trucks so that the truck may catch up with the demands placed upon it by modern high capacity cars. Such standardization, which imposes no restrictions on the designer beyond those necessary to guide development into channels which will cause a minimum of disturbance to the operation and maintenance of equipment in interchange, is highly progressive.

"Breaking grooves" in car structures

In machine and engine design, it is common practice to reduce the cross-sectional area in some relatively inexpensive and easily-replaced part, by machining a "breaking groove," with the idea that, in case of extensive overload for any reason, the machine or engine will break at this point and thus avoid the failure of some more complicated and expensive part of the structure. A somewhat analogous requirement exists in the design of railroad cars, particularly for freight service where excessive shocks are often encountered under present operating conditions. The primary requisite in the design of car couplers, draft gears, draft attachments, etc., is adequate strength to avoid parting of the train under any conditions likely to be encountered. With this as a starting point, it would seem to be good practice to design the car parts having to do with draft in the following order as regards strength: Coupler knuckle and head, coupler shank, draft gear column or housing, draft attachments, and front and back draft gear stops. These parts are the ones which require most frequent repair and renewal in ordinary service and no doubt they could be so designed as to reduce greatly the expense from this cause. It is generally far easier and less expensive, however, to repair a broken draft gear than a broken underframe or other important part in the car structure. In effect, therefore, the parts mentioned should serve as a "breaking groove" in the abnormal shocks and stresses into the car body itself.

Attempts to increase locomotive efficiency

Readers of the *Railway Mechanical Engineer* will find much of interest and value in the two articles "Attempts to increase locomotive efficiency," by A. I. Lipetz, consulting engineer, American Locomotive Company, the first one of which appears elsewhere in this issue. As is to be expected, Mr. Lipetz devotes the larger part of his discussion to the locomotive boiler, as it is the output of the boiler that finally determines the capacity of the locomotive. In this connection, two significant statements are made in the first article appearing this month that are worth considerable thought and study.

Mr. Lipetz says, "As regards boiler efficiency, it has about reached its limit. It must be remembered that high boiler efficiencies are usually obtained at low firing and evaporation rates and that at high rates the boiler

efficiency drops sometimes to below 50 per cent." Further on in the article he states, "Great possibilities are opened in two directions; namely, in the raising of the boiler pressure and in the lowering of the back pressure and that of these two, the latter is even more tempting than the former. This explains why the problem of lowering the back pressure has been tackled first."

The author's discussion of these two developments is enlightening. He has not only discussed the theoretical aspects pertaining to the general subject, but he has cited as examples the important developments in design and actual construction in both Europe and America. Mr. Lipetz has prepared a dramatic story of the career of the steam locomotive that should especially appeal to all mechanical department officers.

Smoke-an unpopular topic

About the least popular topic in any discussion of locomotive terminals is smoke. Yet, why refuse to discuss it, or admit that locomotive smoke is really a nuisance, particularly where the terminal is located in a city that has become acutely smoke-conscious. Either smoke ducts leading to a central disposal stack, smoke washers, or a modern stationary boiler plant for steaming up locomotives and holding them under steam without fires on the grates have proved an effective means for preventing objectionable smoke. Any of these measures makes for better working conditions in the enginehouse, and there is an element of fuel economy as well as other operating advantages associated with the latter method, as has already been pointed out in the recent article describing a fireless engine terminal on the Grand Trunk Western at Chicago. About 40 locomotives are being turned daily at this terminal without a locomotive fire in the 23-stall enginehouse. Equally effective from a smoke abatement standpoint is the smoke washer recently installed by the Pennsylvania in Chicago. A good example of what can be accomplished toward permanently solving the smoke problem at a new locomotive terminal erected within city limits is to be found in the Riverside terminal of the Big Four, recently completed at Cincinnati. The location of this enginehouse at the foot of a hill already dotted with residences compelled attention to the smoke problem, which has been satisfactorily solved by the fireless steaming system mentioned. In the construction of new terminals on the outskirts of large cities where there is no immediate demand for smoke abatement, consideration should be given to the possibility of future real estate developments that may later make this a serious problem.

Help reduce arbitration cases

In presenting the report of the Arbitration Committee during the Mechanical Division convention, held at Atlantic City in June, T. W. Demarest, the chairman of the committee, called attention to the fact that during the past year the committee had handled less than the usual number of arbitration cases. This fact indicates that those responsible for handling these cases are getting a better understanding of the rules and are becoming a bit more reasonable in applying them. However, it is believed that the number of cases which the Arbitration Committee is called on to decide could be further reduced if questions involving Rule 32 were settled by the railroads according to the principles clearly defined in the rule and well established by repeated decisions of the committee itself. Of the arbitration cases reviewed in the *Railway Mechanical Engineer* during 1927, 30 per cent involved Rule 32. About 31 per cent of the cases reviewed so far this year also involve this rule. In all these cases involving Rule 32, approximately 80 per cent of the decisions refer back to decisions previously rendered. In one instance the committee referred to the decisions in four previous cases as all paralleling the case under consideration. These figures indicate plainly that some railroads either are not sincerely trying to settle disputes involving Rule 32 according to the clearly defined conditions set forth in the rule, or are acting on the belief that special conditions in their cases, not covered in the rule, justify the committee in rendering decisions not strictly in accord with the letter of the rule. This the committee has consistently refused to do. Indeed, had it done otherwise, the value of the rule would long since have been destroyed. It may not be doubted that cases occasionally arise in which the strict application of the letter of Rule 32 does not result in ideally even-handed justice. The value of the rule must not be determined by the results in such special cases however, but rather by the proportion of essential justice resulting from its application to all the cases involving any of the conditions which it is written to cover. Judged by this standard, Rule 32 is a very good rule, and if, before submitting any case already covered by a previous decision, the responsible officer of each road would consider that a decision contrary to established interpretations, for his special benefit, would tend to destroy the protection which the rule renders to his road in probably 90 per cent of the settlements under it in which his road is involved, the work of the Arbitration Committee would be still further greatly reduced.

Engine truck lubrication

One of the subjects receiving special attention at the recent Mechanical Division convention at Atlantic City, N. J., was engine truck lubrication, referred to briefly in the locomotive lubrication report. There appears to be no doubt that more or less general difficulty is being experienced in lubricating this important locomotive part because of the severe service to which it is subjected and the relatively inaccessible location of truck journal boxes.

The committee stated that floating bushing bearings are being developed in an effort to improve engine truck lubrication, and went on record that outside-bearing truck frames, where they can be used, are an improvement over the inside-bearing type with cellars. Another idea, now receiving widespread acceptance, is that oil holes, drilled in the tops of engine truck brasses, have a tendency to permit oil to be pumped through the tops of the brasses instead of allowing it to follow around the bearings. This can be avoided by plugging the holes and providing oil channels to convey oil poured on top of the brasses into the cellars from which it will feed through the packing to the journal.

The difficulty in lubricating engine truck boxes is accentuated, as brought out by the discussion on the floor of the convention, by extended locomotive runs, by the presence of sand and similar abrasive material on roads traversing desert country and by sharp curves in mountain territory. In fact, in the latter case, the generation of heat due to pressure on engine truck hub plates is apparently the main cause of hot boxes and consequently the condition which must be remedied before any permanent solution of the problem can be obtained.

One suggestion advanced was that grease be supplied between the hub plate and truck box by means of a hole

through the wheel hub, due caution being observed to keep the hole strictly within the limits of the main hub and drilling it without offsets or sharp corners. This method implies the use of some pneumatic or other high-pressure grease system. Special engine-truck boxes and cellars, with mechanical oil feed to the journals, have been developed, and one of six roller-bearing engine trucks has now been in service over a year, making in excess of 100,000 miles and holding considerable promise, not only of reducing friction and lubrication expense, but eliminating side thrust difficulties.

These developments give reason for the hope that the problems involved in effective engine truck lubrication, now engaging the active attention of mechanical department men, will be solved or greatly minimized in the near future.

How to get terminal improvements

While numerous examples of well-equipped modern engine terminals, constructed in the past few years, have contributed substantially to improved railroad operation, the statement can hardly be denied that by far a great majority of present engine terminals are not modern. Some extremely interesting facts regarding terminal conditions were developed at the April meeting of the Western Railway Club, in which the principal address was made by J. S. Morris, engineer of shops and machinery of the Nickel Plate.

Besides commenting on the numerous labor,—time—and fuel-saving features, now being incorporated in many modern terminals, such as up-to-date coal and cinder handling equipment, hot water boiler-washing and direct-steaming facilities, three-point bearing turntables, modern drop tables, electric crane trucks, pneumatic communication tubes, electric locomotive blowers, etc., Mr. Morris said that the success or failure of local terminal supervisory forces in getting the improvements which they desire depends largely upon the manner of presentation of the needs to the management. He mentioned a case in which a certain terminal was badly handicapped by the lack of proper ash-handling facilities, and the installation of a modern cinder plant would have avoided congestion and greatly improved the operation. Requests for this cinder plant were made each year for a number of years without any action being taken. Finally the request was prepared and presented in a totally different manner. A plan was developed showing in detail the exact location and arrangement of the improvement recommended, the first cost and estimated subsequent maintenance cost of each detail also being shown. The savings in labor and improved operation were then set down in detail and balanced against the total cost, a net profit of 27 per cent being shown on the investment, after deducting 10 per cent for interest and depreciation. Very shortly after the request reached the management, the improvement was authorized and instructions were issued to order the necessary apparatus by telegraph and to install it immediately.

While the prompt action in this case may have been accidental, it is certain that the fully-developed financial, as well as physical, side of the improvement plan proved very appealing to the executive officer responsible for signing the A. F. E. In general, mechanical department supervisors pay too little attention to the financial part of the problem of justifying improvement installations. The collection and presentation of accurate figures of costs and savings represent much investigation, study and work. It is much easier for an enginehouse, or shop foreman either, for that matter, to give his boss a list of the new tools, labor-saving devices and other improvements he needs, and let somebody else figure out which he needs most and which will give the largest return on the investment. If the president of the road were to visit *your* division, enginehouse, shop, or sub-department today, could you tell him what you needed and why, how much it would cost, and what the savings would be? Unless you can answer this question in the affirmative, are you entirely fulfilling the responsibilities of your position?

New Books

SAWARD'S ANNUAL, 1928. *By Frederick W. Saward, 256 pages, 6 in. by 8 in. Published by Saward's Journal, 15 Park Row, New York.*

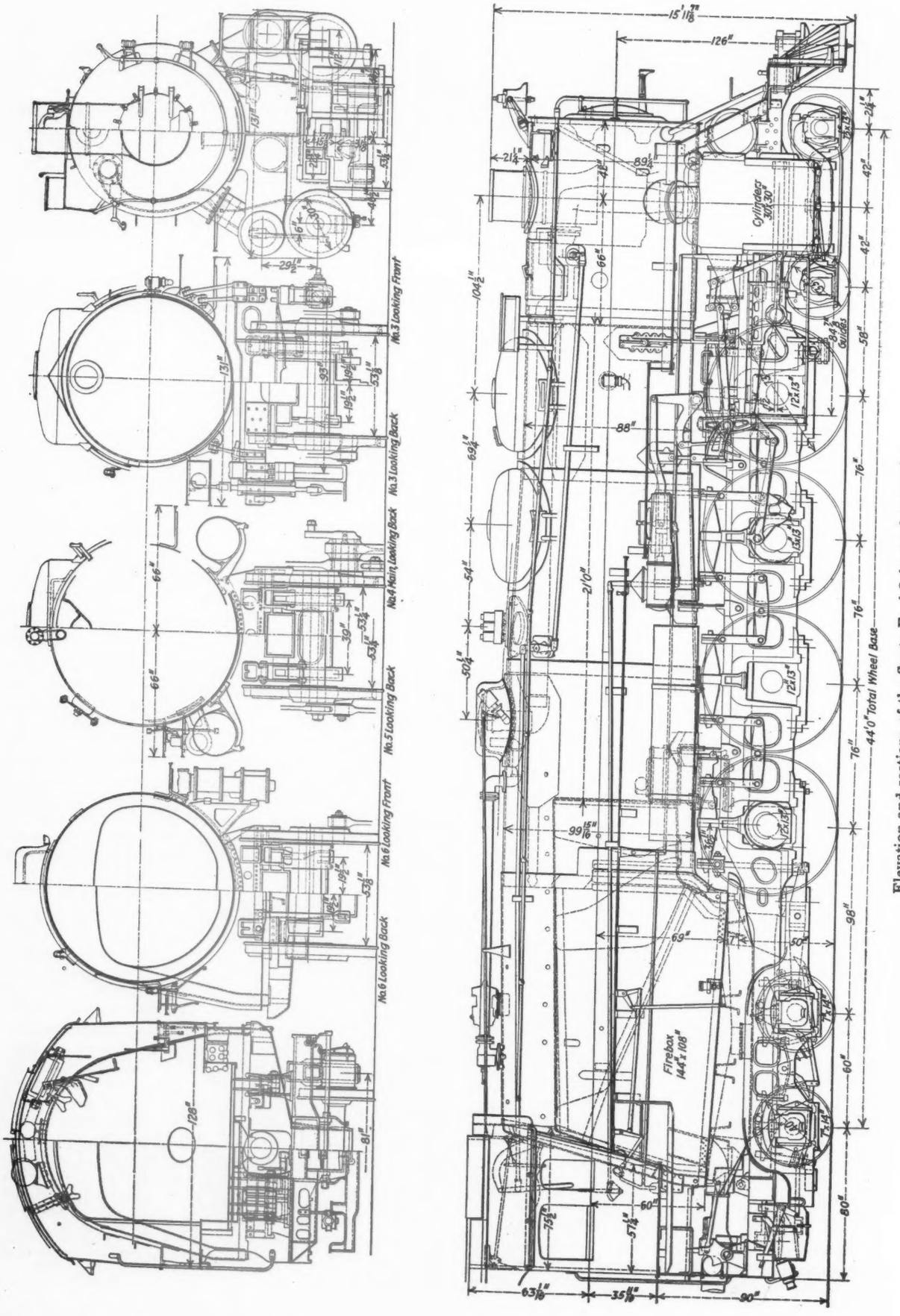
Saward's Annual is a statistical review of the coal trade, embracing the details relative to output, prices, freight rates, transportation, exports, trade conditions, computing tables and other details of importance to the coal man, both wholesale and retail. This, the tenth edition, contains statistics for 1927 or latest available dates.

TWO ESSAYS IN EARLY LOCOMOTIVE HISTORY. *By C. F. Dendy Marshall, M. A., M. Inst. Loco. Engrs. 120 pages, illustrated, 8½ in. by 11 in. Price 12 s. 6 p. Published by the Locomotive Publishing Company, Ltd., 3 Amen Corner. London, E. C. 4, England.*

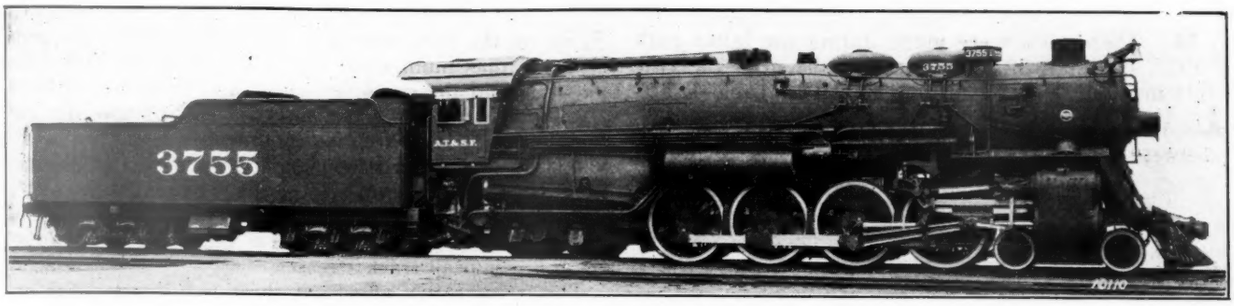
The subjects of the two essays contained in this book by Mr. Marshall are: The first hundred railway engines; and British locomotives in North America. Mr. Marshall, who is the author of several other books on railroad subjects, the most notable of which is, The Resistance of Express Trains, has made a sincere attempt to present the history of the early locomotive in connected form. He has gone to considerable pains to ascertain the true facts in connection with the first hundred railway locomotives and has used first-hand references as much as possible. Although the book is of primary interest to British readers, many American railway men will find much of interest contained in its pages.

THE ABRASIVE HANDBOOK. *Compiled by Fred B. Jacobs, editor of Abrasive Industry. 550 copiously illustrated pages, 6 in. by 9 in. Published by the Penton Publishing Company, Cleveland, Ohio. Price $5.*

This book is a complete reference work on abrasives and grinding practice for the manager, abrasive engineer, superintendent, foreman, grinding machine operator and student. It points out what classes of work can be ground advantageously and it answers practically most questions which confront the users of abrasive materials or grinding machines. It covers every phase and modern use of abrasives of all kinds, both natural and manufactured, together with all grinding processes used in up-to-date production, and includes a complete list of abrasive producers. It includes all the compositions of abrasive material, gives standards, weights, formulas, solutions, etc. Every table that is likely to be used in abrasive engineering is recorded in the book. The book is divided into 14 sections and contains over 200 illustrations.



Elevation and sections of the Santa Fe 4-8-4 type locomotive



Atchison, Topeka & Santa Fe 4-8-4 type locomotive, built by the Baldwin Locomotive Works

Modified Mountain locomotive for the Santa Fe

Features include economy, high boiler capacity, special weight distribution and cross counterbalancing

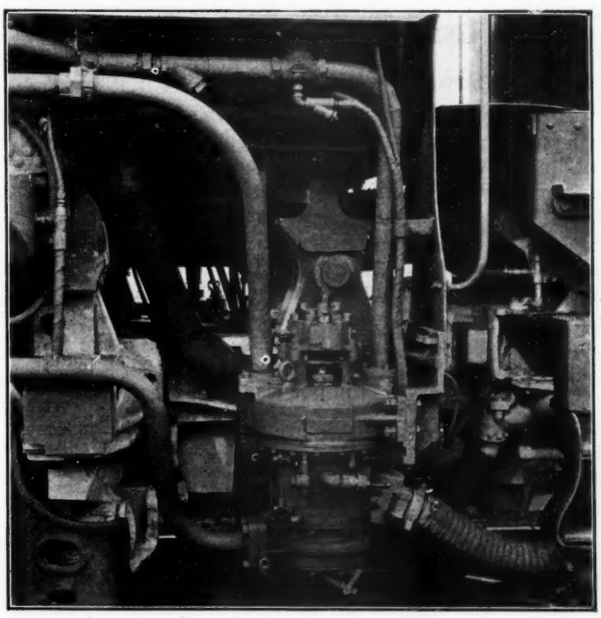
WITH the principal object of handling heavier passenger trains faster and with less unit fuel consumption, the Atchison, Topeka & Santa Fe designed, and placed in service during the past year, 10 modified Mountain type coal-burning locomotives of 4-8-4 wheel arrangement, known on the Santa Fe as the 3751 class, and numbered from 3751 to 3760 inclusive. These locomotives, built by The Baldwin Locomotive Works, are of the two-cylinder single-expansion type, equipped with 30-in. by 30-in. cylinders and 73-in. driving wheels, and develop 66,000 lb. tractive force at a boiler pressure of 210 lb. without the aid of a booster.

The new locomotive is notable for high boiler capacity, evaporating in one test an average of 6.74 lb. of water per lb. of coal when burning low-grade Colorado mine run at the rate of 4,125 lb. of coal an hour. The combustion-chamber firebox, with a total grate area of 108 sq. ft. and round-hole table grates, is designed to assure a low rate of firing per sq. ft. of grate area and as nearly complete combustion as practicable before the gases pass into the flues. In order to accommodate this large firebox, a non-articulated four-wheel trailing truck, which has been in the process of development on the Santa Fe since 1919, is applied. Driving axle loads up to 70,600 lb. are used on certain pairs of wheels, yet without excessive rail stress on either tangent track or curves, due to careful spring equalization, proper counterbalancing of the reciprocating and revolving weights and cross counterbalancing the revolving weights on the main wheels to offset the effect of these weights moving in different planes.

Favorable operating results secured

Operating results secured with the 3751-class locomotive under actual service conditions have exceeded the expectations. This locomotive has demonstrated the ability to start 26 cars of heavy modern equipment on level track, or 15 cars on a 1.13-per cent grade, in the latter case accelerating to a speed of 20 to 25 miles per hour in a distance of 15 car lengths. In the mountain districts of Colorado, New Mexico and Arizona, the locomotive handles 15 cars over grades up to two per cent and 9 cars over the 3½-per cent grade of the Raton mountains, without a helper. Sixteen-degree curves can be negotiated. The locomotive is said to handle easily, accelerate rapidly and ride easily, especially on curves, which the locomotive is designed to pass with a minimum of flange and rail stress and nosing.

In general, because of slack business, the new locomotives have not been operated to full capacity since being placed in service and, consequently, maximum results with respect to fuel economy could not be expected. A good indication of their performance is afforded, however, by the results of comparative tests of locomotive No. 3751 and locomotive No. 3714, a previous Santa Fe Mountain type locomotive, on the 347.5-mile run between La Junta, Colo., and Albuquerque,



The Elesco centrifugal feedwater pump located below the cab

N. M. These tests were made during the latter part of 1927, operating in both directions between the two points mentioned. The results, shown in Table I, are

Table I—Comparative test of locomotives 3714 and 3751 between La Junta and Albuquerque—Average of five round trips burning mine-run coal

	Loco. 3714	Loco. 3751	Percentage in favor of Loco. 3751
Total time, hr.	11.47	11.65	——
Dead time, hr.	1.32	1.72	——
Running time, hr.	10.15	9.93	——
Speed, m.p.h.	34.25	35.0	2.2
No. stops	12	13	— 7.70
No. cars	10.5	14.5	38.1
Train tonnage	782	1,037	33.30
1,000 ton-miles	263.9	350.4	32.50
Coal used, lb.	59,640	48,060	19.40
Water used, gal.	33,520	35,370	— 5.50
Million foot lb. work	13,380	18,537	38.60
Coal per 1,000 ton-miles, lb.	226.2	138.6	38.7
Water per 1,000 ton-miles, lb.	1,058	930	12.1
Coal per million ft.-lb., lb.	4.46	2.55	42.8
Water per million ft.-lb., lb.	20.7	17.4	15.95
Lb. water per lb. coal	4.70	6.74	43.40

Note: Values marked thus (—) are in favor of Locomotive 3714 which, for an accurate comparison, should be credited with about 10 per cent better showing in all fuel factors because of not being equipped with a feedwater heater.

the averages of the performance figures for five round trips.

Referring to the table, it will be noted that locomotive No. 3751 handled four more cars at a slightly higher average speed than No. 3714. It handled, on an average, 33 per cent more tons per train and developed a proportionately greater number of ton-miles. In making comparisons of fuel consumption, consideration must be given to the fact that locomotive No. 3714 is not equipped with a feedwater heater and, accordingly, should be credited with about 10 per cent better performance. The balance of the improvement shown by locomotive No. 3751, however, is due to improvements in design, and amounts to a saving of roughly one-third of the fuel per unit of work which locomotive No. 3714 consumes under the most favorable circumstances. It will be noted that locomotive No. 3751 evaporated an average of 930 lb. of water and burned 138.6 lb. of coal per 1,000 ton-miles, or at the rate of 6.74 lb. of water per lb. of coal during these tests. All tests were made burning Colorado and New Mexico mine-run coal on round-hole table grates with 16-per-cent air openings.

Track stress limited

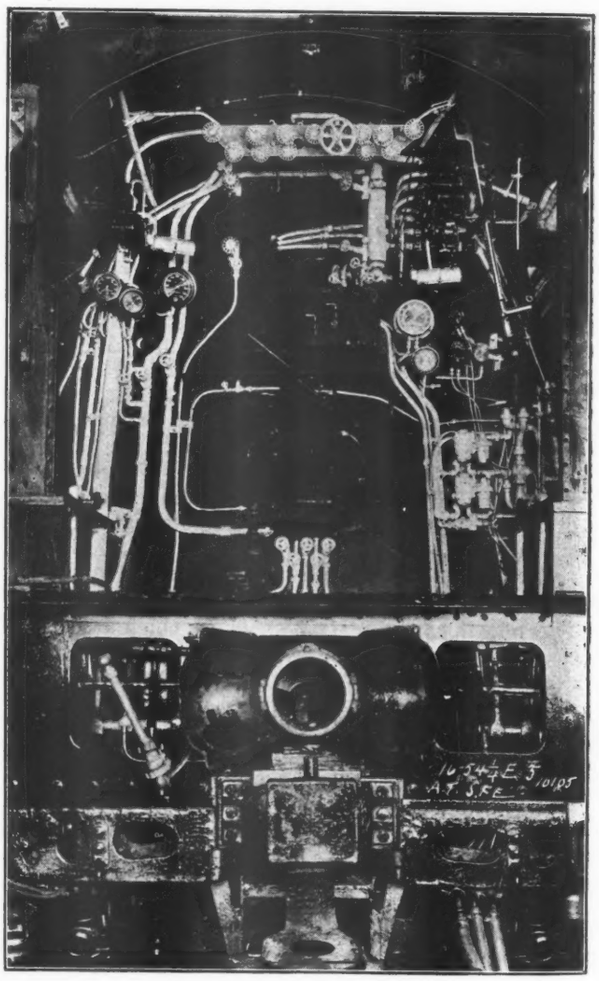
As a result of studies made on the Santa Fe during the past few years with a view to determining the wheel loading, distribution of weights and method of counterbalancing which will keep track stress within safe limits, a loading of trucks and driving axles of locomotive No. 3751 was adopted as shown in Table II. For purposes of comparison, the wheel loads of locomotive No. 3710, a previous Santa Fe Mountain type locomotive, are also given in this table.

Table II—Comparative driving axle and truck loads in pounds

	Locomotive 3751	Locomotive 3710
Engine truck	63,500	58,100
No. 1 wheels	66,300	61,350
Main wheels	70,600	60,850
No. 3 wheels	66,500	60,550
No. 4 wheels	66,000	60,350
Trailer truck	92,600	66,500

All of the driving wheels on locomotive No. 3751 have flanged tires, and no driving box lateral motion device is provided. The tires on No. 1 and No. 4 wheels are set ⅛-in. nearer together than on the main and No. 3 wheels. Three-eighths inch lateral motion is provided on the front truck wheels, 3/16 in. on all drivers and on the forward trailer truck wheels, and ⅜-in. on the back wheels of the trailer truck. In general, the maximum static loads were kept to 70,000 lb. per axle and the combined static and dynamic loads to 76,000 lb. per axle. The effectiveness of this design, together with accurate cross counterbalancing and a division of the trailer-truck load between two axles, has been such as to permit increasing driving-axle loads almost 10,000 lb. in locomotive No. 3751 as compared with locomotive No. 3710 and at the same time to develop lower peak track stresses.

The comparative effects of these two locomotives on tangent track at 60 miles per hour are plainly shown in Chart I which gives the equivalent static load on each

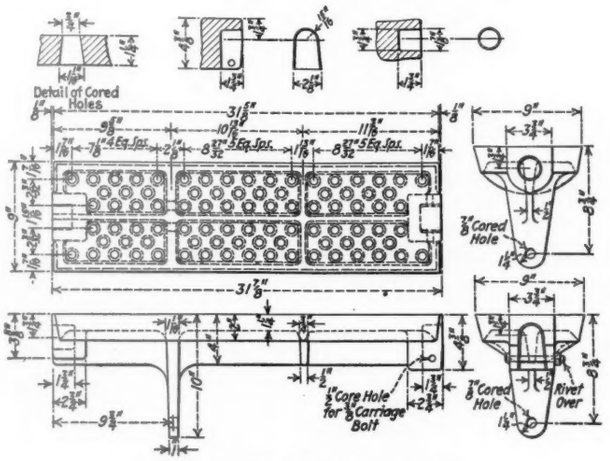


The back boiler head

pair of drivers through a complete revolution. A glance at the chart shows that in locomotive No. 3751, the No. 1 driving wheels have been made to take more nearly a fair share of the equivalent static load than was the case with locomotive No. 3710, and as a result, the main and particularly the No. 3 wheels have been relieved of excessive loading. The chart shows that locomotive No. 3751 at 60 miles per hour on tangent track provides about 3,000 lb. less maximum equivalent static load on the rails than locomotive 3710, in spite of having from 9 to 15 per cent greater individual driving axle loads.

The stresses in both rails occasioned by locomotive 3751 passing a 10-deg. curve at three different speeds are shown in Chart II. In general, this chart indicates

that the loads are fairly well distributed between the driving wheels and trucks under all curve and speed conditions; at least excessive peak loads from any one pair of wheels are avoided. Similar charts to those reproduced here for locomotive No. 3751 were developed for locomotive No. 3710 and published in the 1926



The round-hole table grate

proceedings of the American Railway Association, Mechanical Division. In fact, the results of the tests reported at that time served as the basis for the distribution of wheel loads in the present locomotive.

To illustrate how peak rail loads have been avoided by the design of locomotive No. 3751, a reference to the diagram for locomotive No. 3710, published in 1926, shows that at five miles an hour the No. 3 driving wheels cause a stress of about 46,000 lb. per sq. in. on the outside edge of the base of the inner rail on a 10-deg. curve. With locomotive No. 3751, this stress at the slightly greater speed of 10 miles an hour has been reduced to 32,000 lb. per sq. in., as indicated in Chart II. At 25 miles an hour on the same curve, the No. 3 wheels of locomotive No. 3710 cause a maximum rail stress of about 35,000 lb. per sq. in., whereas the No. 3 wheels on locomotive No. 3751 cause a stress of only 32,000 lb. per sq. in. The records show that the trailer wheels of locomotive No. 3710, in passing a 10-deg. curve at 25 or more miles an hour, introduce a stress in excess of 40,000 lb. per sq. in. in the outside edge of the base of the outer rail. The trailer truck design on locomotive No. 3751, with the division of the load between two axles and a substantially shorter distance between the No. 4 driving and No. 1 trailer wheels, overcomes this difficulty.

General discussion

In conjunction with the desire for high capacity, fuel economy and reduced track stress, an effort has been made in the design of the Santa Fe 3751-class locomotives, to produce a type which requires less maintenance expense than some of its predecessors. Although no definite figures are available, this has undoubtedly been accomplished to a considerable degree, since locomotive design which reduces the destructive effect on track and roadway must necessarily involve the equalizing of unbalanced forces in the locomotive structure itself and consequently reduce wear and tear and resultant maintenance.

The 3751-class locomotive is equipped with one-piece cast steel cylinders and a separately cast Commonwealth bed frame. A Type E superheater with American multiple throttle is installed, also Nicholson thermic syphons in both the firebox and combustion chamber. The Elesco feedwater-heater installation includes a centrifugal pump designed to avoid pulsations which, under certain conditions, accentuate foaming difficulties. Other equipment on this locomotive includes the Ragonnet power reverse gear, Walschaert valve gear with multiplying lever to give nine inches maximum valve travel, Layden four-ported exhaust nozzle, 25½-in. diameter smokestack and insulated smokebox.

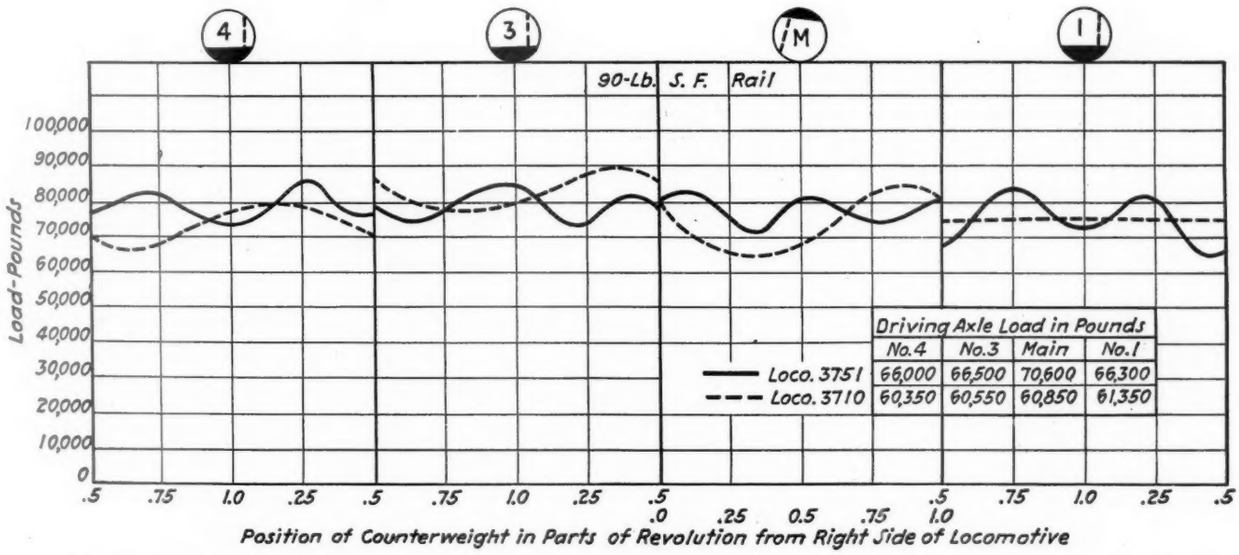
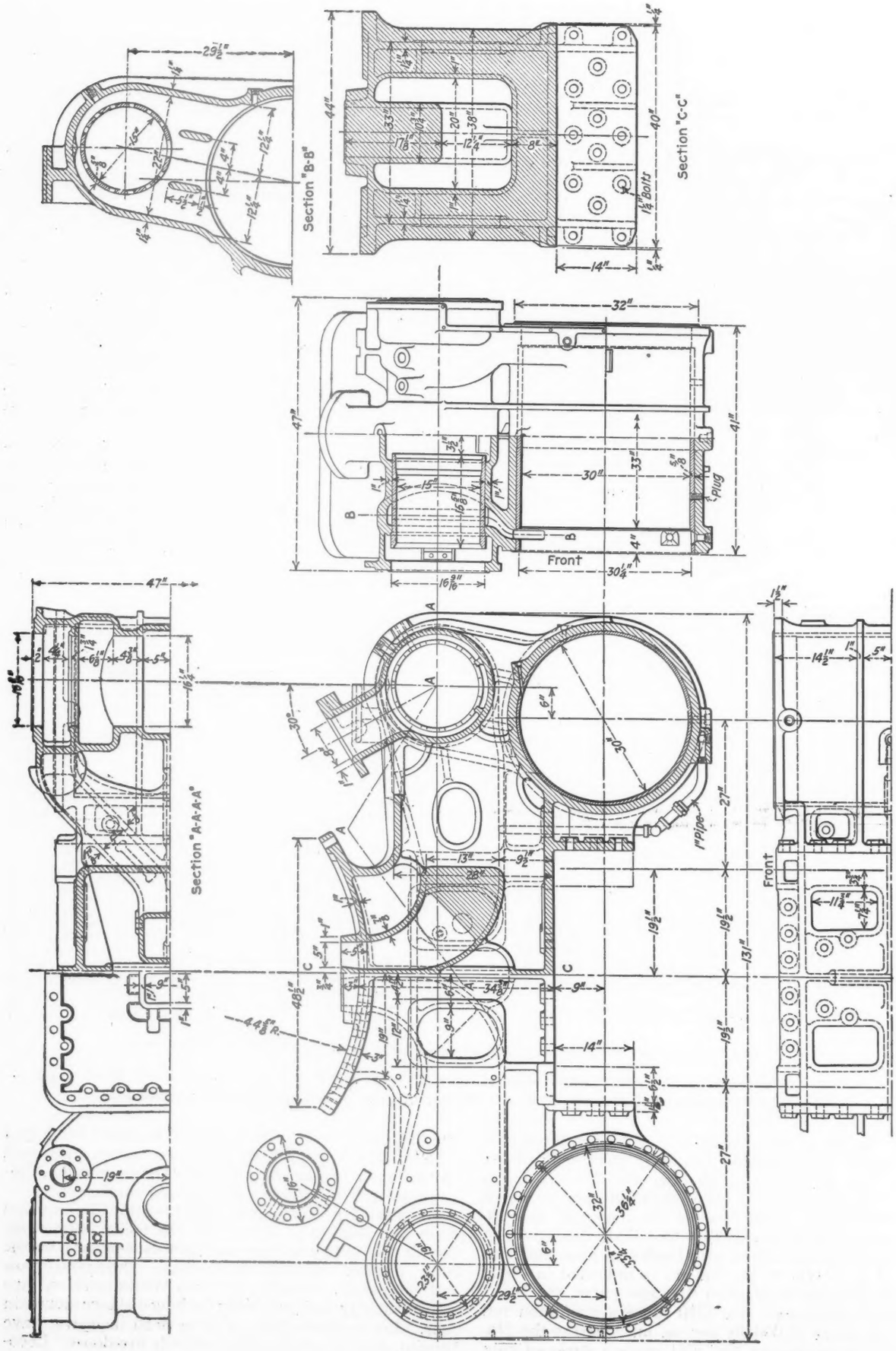


Chart I—Comparative effects of 3751 class and previous Mountain type locomotives on tangent track at 60 m.p.h.—The chart shows equivalent static load on each pair of drivers through a complete revolution

An auxiliary dome, just ahead of the main steam dome and slightly to the left of the boiler center line, carries the safety valves and affords entrance to the boiler without removing the dry pipe. Dual sand boxes and equipment, including Graham-White sanders, give ample capacity and reliability for long distance mountain runs. Locomotives Nos. 3752 to 3756 inclusive, have Dupont stokers and Franklin butterfly fire doors. Loco-



General dimensions and arrangement of one-piece cast-steel cylinders which are a feature of the Santa Fe 4-8-4 locomotive

motives Nos. 3751 and 3757 to 3760 inclusive, have Duplex stokers and Franklin vertical fire doors.

Alloy steels are used to a limited extent in the construction of these locomotives. The main driving wheel centers are of high tensile strength steel. The hollow main crank pins, as well as the piston rods, are made of oil-quenched and tempered chrome-nickel steel. Main and side rods and crank pins, other than the main, are carbon steel, normalized. Steam-pipe and superheater bolts in the smokebox are made of chrome-nickel steel, heat treated. Phosphor-bronze driving box brasses and nickel-bronze floating rod bushings are used.

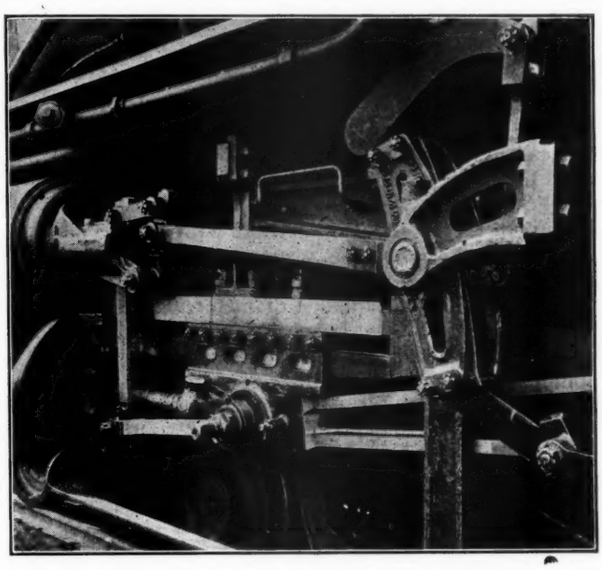
The locomotive tender is constructed with a Commonwealth one-piece cast steel underframe having end sills cast integral and designed to accommodate the Franklin unit drawbar arrangement. Six-wheel trucks are applied, with cast steel side frames having riveted liners on the pedestal wear faces. Tatum-Zell type journal boxes are used. The tender has a capacity for 15,000 gal. of water and 20 tons of coal. The general dimensions of the new locomotive, as compared with a previous mountain type locomotive, are given in Table III.

Cylinders and running gear

The cylinders of the 3751-class locomotive are combined in a one-piece steel casting representing a saving in weight of approximately 25 per cent over cylinders of cast iron. This steel cylinder casting is bolted and keyed to a locomotive bed and cradle frame cast of steel in one piece, with separate steel front deck casting in order to facilitate repairs in case of accidental collision. The steam and exhaust passages of the cylinders are designed free from restrictions and obstructions to the flow of steam. The exhaust passages are gradually reduced in area from the valve bushings to the base of the exhaust pipe in such a way that the cross section at no point is larger than a preceding section. All fillets have at least ¾ in. radius.

The front engine truck is of the constant-resistance type with Commonwealth cast-steel frame, 33-in. solid rolled steel wheels, and 6-in. by 11-in. journals. The trailer truck is of the four-wheel Delta type with constant-resistance rockers and has a one-piece cast-steel frame. Both pairs of trailer wheels are 40 in. in diameter, the journals being 9 in. by 14 in. Brass pedestal wearing liners are riveted to the truck frame.

The driving wheels are 73 in. in diameter, and in order to apply a boiler of the desired diameter and capacity, it was found necessary to use driving springs with reverse camber. The driving wheel centers are 66 in. in diameter and mounted on hollow-bored axles, the main axle being 13 in. in diameter and the others 12 in. The main crank pin also is hollow-bored with a four-inch hole to reduce weight and provide for delivery of grease under pressure to the center of the main and side rod floating bushings. Flange tires are provided on all driving wheels, spaced as follows: Front wheels, 53⅛ in.; main wheels, 53¼ in.; No. 3 wheels, 53¼ in.; No. 4 wheels, 53⅛ in. Revolving weights and 50 per cent of the reciprocating weights are counterbalanced, revolving weights in the main wheels being cross-counterbalanced. The static and dynamic load on these wheels is kept under 76,000 lb. per pair of wheels.



Walschaert valve gear arranged for long travel

The driving boxes have a bearing 13 in. long on the journals and are equipped with phosphor-bronze brasses with babbitt inserts and Elvin grease cellars. The shoes and wedges are also made of phosphor bronze. The normalized carbon-steel main rods have floating bushings on the back ends and front ends tapered to prevent galling in the reinforced Laird type crossheads. Grease cups are forged solid with the rod and off center to give a stronger construction. Pistons are of the Universal three-bull-ring type.

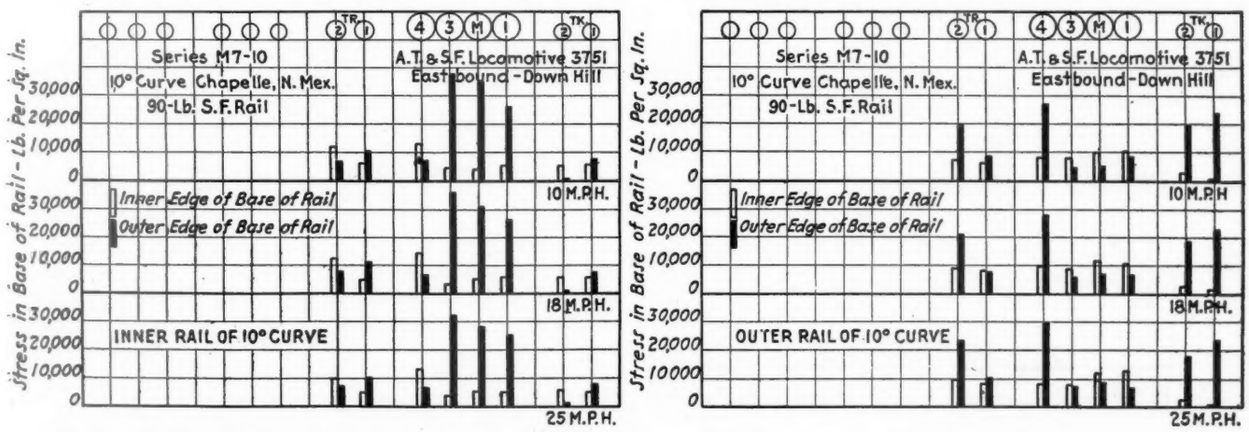
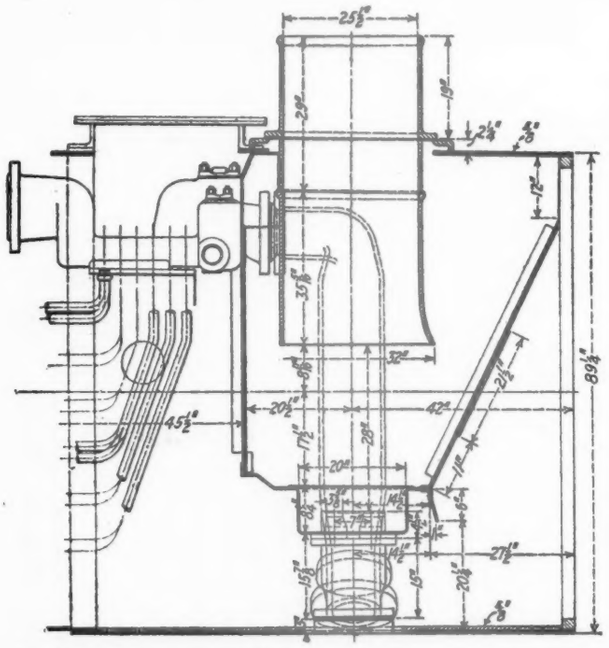


Chart II—Stress in inner and outer rails of a 10-deg. curve occasioned by the passing of a 3751 class locomotive

Walschaert valve gears are supplied with an additional lever interposed between the radius rod and combination lever and pivoted at the rear end of the back valve chamber head. This arrangement, covered by a patent application, magnifies the motion produced by the link but does not affect the motion produced by the combination lever and affords a longer valve travel than usual with the Walschaert gear without exceeding the normal limits of angularity. The maximum travel obtained is nine inches, and in order to take full advantage of this travel and permit finer adjustments of cut-off, the Ragonnet power reverse gear is operated from the cab by a reverse lever and quadrant cut with more than the usual number of teeth.

The boiler of the new locomotive is designed for a minimum factor of safety of four with a boiler pressure of 225 lb. It is of the wagon-top type, with conical barrel, the rear course of which is 99-15/16 in., and the first course 88 in. in outside diameter. The firebox has a grate area of 108 sq. ft. and is equipped with two 3½-in. arch tubes, and two Nicholson thermic syphons. The combustion chamber is equipped with one thermic syphon. There are 221 superheater flues, 3½ in. in diameter by 21 ft. long; and 59 tubes, 2¼ in. in diameter and of the same length. All of the superheater flues

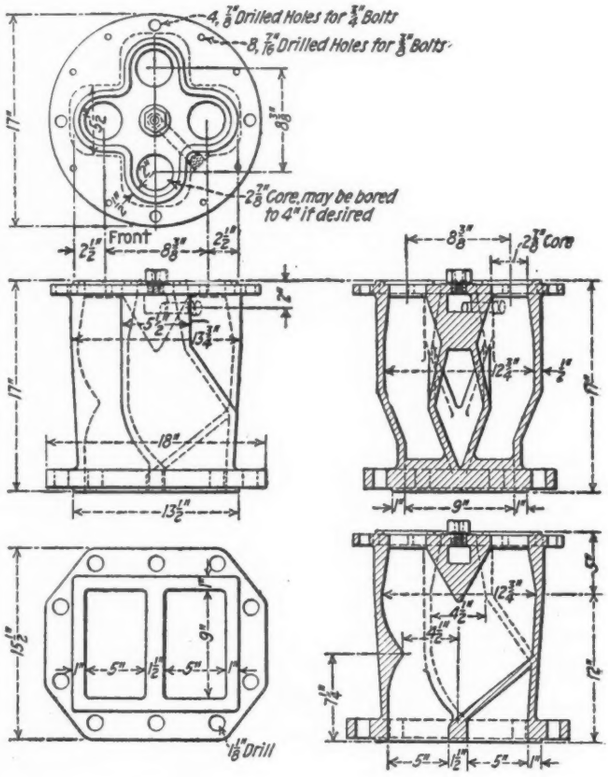


Smokebox arrangement, with the Layden exhaust nozzle

are electric welded to the back flue sheet and beaded in the front.

The wrapper sheet for this boiler is made in three pieces. The firebox and combustion chamber sides and crown sheet are also made in one piece and welded. The cast steel mud ring, double riveted throughout, is arranged with a pad 1 in. thick riveted to the underside of each corner and welded, inside and out, 12 in. each way from the corner. All firebox seams also are welded 50 in. up from the bottom of the sheets. Flannery flexible staybolts with universal sleeves are used in the braking zones and completely around the combustion chamber, these bolts being hollow and arranged for electric testing.

In addition to the main steam dome, pressed from a single piece of openhearth steel, an auxiliary dome is located ahead of the main dome and far enough to the left of the boiler centerline so that the 9½-in. inside dry pipe will not prevent entrance to the boiler for inspection or other purposes. The smokebox is of the



Details of Layden exhaust pipe

extended type, 89¼ in. in outside diameter, with a pressed-steel front-end door and door ring hinged to the smokebox by an Okadee front-end hinge.

The front end arrangement consists of a Type E superheater header with American multiple throttle included, and steam pipes passing through the lower part of the smokebox to the steam chests. A Layden four-ported exhaust nozzle is provided, exhausting into a stack which extends 21¼ in. above the smokebox, and is choked to a diameter of 25½ in. The smokestack saddle is electric welded to the smokebox all around. The smokebox is insulated with one-inch magnesia block lagging, the jacket being pocketed around the superheater header bolts. The front end door and ring are also lagged on the inside and protected by a 3/16-in. plate. Lagging of the smokebox is done in accordance with standard Santa Fe practice, not only to conserve heat but also to save labor and expense in painting.

An Elesco feedwater heater is located on the front deck, and is fed by a centrifugal feedwater pump under the cab on the left side of the locomotive. Special Barco flexible ball joints are used at points where the feedwater pump discharge pipe enters and leaves the heater. It will be noticed the steel cab, which is lined with wood, is located entirely back of the back boiler head, thus giving ready access to washout plugs and flexible staybolt caps simply by removing sections of the jacket and lagging. The cab is anchored by bolts to five brackets on the back boilerhead, also by being

bolted to the running boards through suitable angle irons. In general, piping in the cab is arranged neatly and the equipment located so as not to interfere with a ready view of gages, water glasses, lubricators, etc.

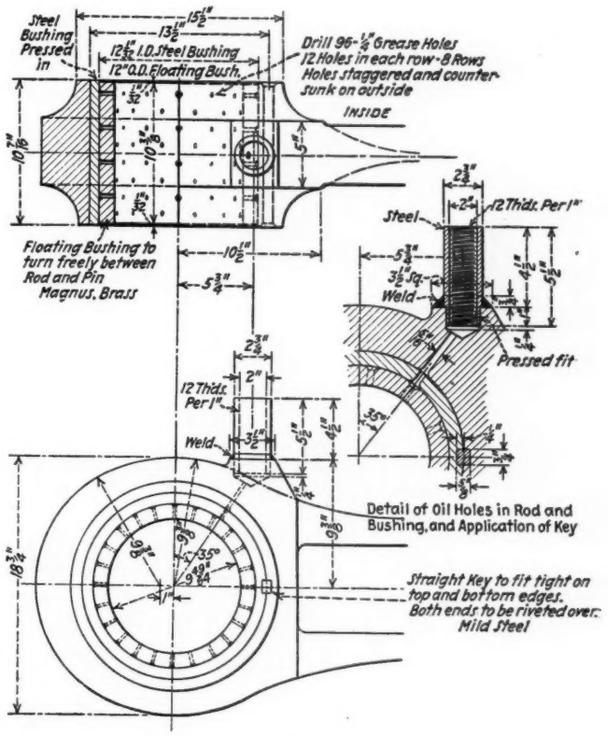
Table III—Comparative dimensions of Santa Fe 4-8-4 and 4-8-2 type locomotives

	3751 Class	3700 Class
Railroad	A. T. & S. F.	A. T. & S. F.
Type of locomotive	4-8-4	4-8-2
Service	Passenger	Passenger
Rated tractive force at 85 per cent cutoff	66,000 lb.	56,000 lb.
Cylinders, diameter and stroke	30 in. by 30 in.	28 in. by 28 in.
Valve gear, type	Walschaert	Walschaert
Valves, piston type, size	15 in.	15 in.
Maximum travel	9 in.	6¼ in.
Outside lap	1⅜ in.	1⅜ in.
Lead in full gear	¾	¾
Cut-off in full gear, per cent	85	85
Weights in working order:		
On drivers	269,400 lb.	243,100 lb.
On front truck	64,600 lb.	51,800 lb.
On trailing truck	87,900 lb.	66,500 lb.
Total engine	421,900 lb.	361,400 lb.
Tender	283,000 lb.	233,720 lb.
Wheel bases:		
Driving	19 ft.	18 ft.
Rigid	19 ft.	18 ft.
Total engine	44 ft.	39 ft. 5 in.
Total engine and tender	37 ft. 2½ in.	76 ft. 8½ in.
Wheels, diameter outside tires:		
Driving	73 in.	69 in.
Front truck	33 in.	33 in.
Trailing truck	40 in.	47 in.
Journals, diameter and length:		
Driving, main	13 in. by 13 in.	12 in. by 12 in.
Driving, others	12 in. by 13 in.	11 in. by 12 in.
Front truck	7½ in. by 13 in.	7 in. by 12 in.
Trailing truck	9 in. by 14 in.	9 in. by 14 in.
Boiler:		
Type	Wagon Top	Wagon Top
Steam pressure	210	210
Fuel	Bit. coal	Bit. coal
Diameter, first ring, inside	86¾ in.	80½ in.
Firebox, length and width	144 in. by 108 in.	122¾ in. by 84¼ in.
Height, mud ring to crown sheet, back	79 in.	77¼ in.
Combustion chamber, length	44 in.	45½ in.
Tubes, number and diameter	57—2¼ in.	254—2¼ in.
Flues, number and diameter	220—3½ in.	43—5½ in.
Length over tube sheets	21 ft.	21 ft.
Tube spacing	3 in.	3 1/16 in.
Flue spacing	4¼ in.	6½ in.
Grate type	Round hole table	Round hole table
Grate area	108 sq. ft.	71.7 sq. ft.
Heating surfaces:		
Firebox and combustion chamber	395 sq. ft.	335 sq. ft.
Arch tubes and syphons	145 sq. ft.	38 sq. ft.
Flues	5,132 sq. ft.	4,419 sq. ft.
Total evaporative	5,672 sq. ft.	4,792 sq. ft.
Superheating	2,250 sq. ft.	1,087 sq. ft.
Comb. evaporative and superheating	7,922 sq. ft.	5,879 sq. ft.
Special equipment:		
Syphons	3	None
Superheater	Type E	Type A
Feedwater heater	Elesco	None
Stoker	Duplex and Dupont	Duplex
Booster	None	None
Tender:		
Style	Water Bottom	Water Bottom
Water capacity	15,000 gal.	12,000 gal.
Fuel capacity	20 tons	16 tons
Wheels, diameter outside tires	33 in.	33 in.
Journals, diameter and length	6 in. by 11 in.	5½ in. by 10 in.
Weight proportions:		
Wt. on drivers ÷ total wt. engine, per cent	.64	.67
Wt. on drivers ÷ tractive force	4.08	4.34
Total wt., engine ÷ comb. heat surface	53.2	61.4
Boiler proportions:		
Tractive force ÷ comb. heat. surface	8.33	9.53
Tractive force × dia. drivers ÷ comb. heat. surface	618	657
Firebox heat. surface ÷ grate area	3.66	4.67
Firebox heat. surface, per cent of evap. heat. surface	5.2	7.0
Superheat. surface, per cent of evap. heat. surface	3.9	2.3
Comb. heat. surface ÷ grate area	73.3	82.0

The cab is steam heated, with a false floor above a radiator on either side. Small hinged doors, one on each side, provide ventilation when necessary.

The combined main and injector steam fountain, located on top of the boiler just ahead of the cab, is carefully lagged and jacketed and has extension rods from all valves passing through the front cab wall and terminating within easy reach of a man standing on the firing deck. A Chicago non-lifting injector is on the fireman's side. A Chicago five-feed five-pint lubricator for cylinder and air compressor lubrication is provided; also a transfer filler as illustrated on the back boiler head. An Ashcroft steam chest and back pressure gage is carried on the same bracket with the air gages in order to be easily read by the engineman. The water column and water glass drain valves have Nicalloy discs and seats. Crane three-inch safety valves are applied in the auxiliary steam dome cover.

Roundhole table grates are used in this locomotive, the air openings totaling 16 per cent of the total area of 108 sq. ft. The grates have tapered holes, ¾ in. in diameter at the top, and set with ½-in. openings between the rocking grates and the grate bars. The top line of the grates is carried 4¾ in. above the bottom of the mud ring. These grates are hand-operated by means of six shaker levers. The ash pan is of the Commonwealth cast steel type with hinged doors for cleaning, and plates to prevent dropping fire around the grate rods at the back end of the pan. One hopper of this ash pan is placed ahead of the front trailer axle and two hoppers are located between the axles.

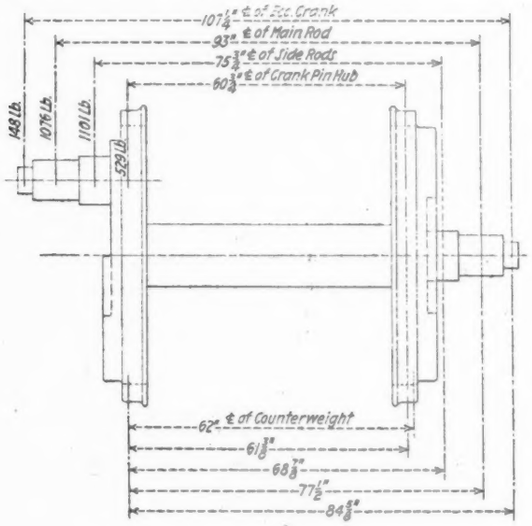

Steel Bushing Pressed in
Drill 96-⅛" Grease Holes 12 Holes in each row-8 Rows Holes staggered and counter-sunk on outside
12" I.D. Steel Bushing
12" O.D. Floating Bush.
INSIDE
Floating Bushing to turn freely between Rod and Pin Magnus. Brass
Steel
12 Thds. Per 1"
Weld
Pressed fit
Detail of Oil Holes in Rod and Bushing, and Application of Key
Straight Key to fit tight on top and bottom edges. Both ends to be riveted over. Mild Steel

Main rod back end, floating bushing type—Grease cup is offset, pressed in and welded

The locomotive is equipped with two oval sand boxes located ahead of the steam dome and having duplicate Graham-White sanders and piping. Sand from the front box is applied to the rails ahead of the front and back of the main drivers. Sand from the back box is applied to the rails ahead of the main and back of the rear drivers. A single Duplex operating valve, located in the cab, controls the application of the sand.

The electrical equipment on this locomotive consists of a Pyle-National Type E-3 steam turbine headlight

generator with a 14-in. Golden Glow silver-back glass reflector and screw type door fastening.



Method of cross-counterbalancing

The method of cross counterbalancing the 3751-class locomotives for revolving and reciprocating weights is as follows:

Distance between plane of counterweight on one side of locomotive to planes of weights to be balanced on opposite side (plane of counterweight on one side of engine being reference plane).

To center of ecc. crank $\frac{107\text{-}¼ \text{ in. plus } 62 \text{ in.}}{2} = 84\text{-}⅝$ in.

To center of main rod $\frac{93 \text{ in. plus } 62 \text{ in.}}{2} = 77\text{-}½$ in.

To center of side rods $\frac{75\text{-}¾ \text{ in. plus } 62 \text{ in.}}{2} = 68\text{-}⅜$ in.

To center of crank pin hubs $\frac{60\text{-}¾ \text{ in. plus } 62 \text{ in.}}{2} = 61\text{-}⅜$ in.

Revolving Weights

One-half ecc. crank plus crank pin	= 120 lb. plus	28 lb. =	148 lb.
Back end of main rod plus crank pin	= 881 lb. plus	195 lb. =	1,076 lb.
Side rods plus crank pin	= 946 lb. plus	155 lb. =	1,101 lb.
Crank pin hub plus crank pin	= 334 lb. plus	195 lb. =	529 lb.
Total			= 2,854 lb.

Counterweight required in each wheel directly opposite crank pin at crank radius

$$\frac{(148\text{x}84\text{-}⅝) \text{ plus } (1076\text{x}77\text{-}½) \text{ plus } (1101\text{x}68\text{-}⅜) \text{ plus } (529\text{x}61\text{-}⅜)}{62} = 3{,}294 \text{ lb}$$

Weight required in counterbalance at 90 deg. to crank pin in order to cross counterbalance over weight in opposite wheel.

3,294 — 2,854 = 440 lb.

Angle of resultant weight equals:—

Tangent $\frac{440}{3294}$ = .133 = 7 deg. 36 min. or say 8 deg. to aliow for cut out for side rods.

Weight required at above angle = $\sqrt{3.294^2 \text{ plus } 440^2}$ = 3,323 at crank pin distance.

One of the drawings shows the main driving wheel counterweight of 3,323 lb. effective at crank radius. This counterweight cross counterbalances the revolving weights.

Static weight on main wheels = 70,500 lb.

Static weight plus dynamic augment not to exceed 75,000 lb. at diameter-speed.

75,000 — 70,500 = 4,500 ÷ 1.5* = 3,000 lb. in each wheel.

$$\frac{3000}{.00034 \times 1.25 \times 336^2} = 62 \text{ lb. reciprocating weight to be balanced.}$$

3,323 plus 62 = 3,385 Weight to be counterbalanced at crank pin distance.

* Arbitrarily assumed to be the ratio of total dynamic augment for one pair of wheels to dynamic augment in each wheel (2-cyl. locomotive, crank pins 90 deg. apart).

The locomotive as a factor in fuel economy*

A discussion of the economies to be expected from available designs and future developments

By A. W. Bruce

Designing engineer, American Locomotive Company, New York

WITH the limitations, now in sight, for future locomotive development, it is probable that the maximum indicated horsepower produced in any single unit will never exceed perhaps 10,000 i.hp. and this is considerably in excess of present-day possibilities. Before reaching this limitation of output, assuming the same inlet and exhaust pressures, questions will be raised as to whether reciprocating engines or turbines are most economical. Until a satisfactory condensing system is found for locomotive work, however, the turbine locomotive need not be seriously considered.

In considering the reciprocating engine indicator card, we find two ways of increasing its area: (1) By an increase in the initial pressure, and (2) by a decrease in the exhaust pressure.

Since condensing offers, so far, the only known means for materially decreasing the exhaust pressure, we are confined to an increase in the initial pressure, in this way differing from both stationary and marine installations where space is not so limited and where varying climatic conditions may be contended with to better advantage. If a condensing system for railroad service is ever satisfactorily brought out, one of the most promising developments will be the maintenance of the present reciprocating type locomotive, but exhausting into a turbine located on the tender, thus providing maximum possible increase in power output for any given wheel arrangement. This system has been under consideration for some time, but so far with no commercially satisfactory results.

The two-pressure stage system

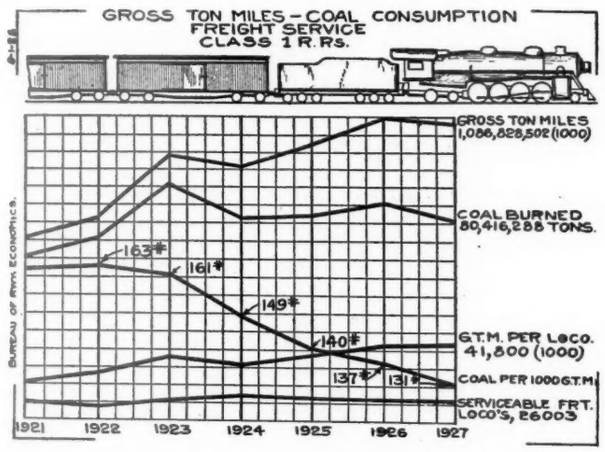
With high-pressure steam in stationary service, the latest practice in some cases uses two installations. The first is a system using comparatively low pressure and differing in no way from present installations; the second or high-pressure system, is imposed on, and exhausts into, the low-pressure system. In this way present installations are considerably increased in power

*Abstract of a paper presented at the convention of the International Railway Fuel Association held at Chicago, May 8 to 11, 1928.

and economy at a comparatively low cost. This, of course, becomes practically a two-pressure stage installation.

This arrangement has already been applied to locomotives and offers one of the most promising solutions known at present. Three cylinders are used, the center cylinder taking the high-pressure steam and exhausting into the two outside cylinders, which also receive a lower-pressure supply from the tubular portion of the boiler.

If we are to retain single-stage initial pressure, we are driven to either compounding or limited cut-off, both of which systems offer some objections, although we find here the poppet valve as an alternate for the better handling of exceedingly high pressures.



This chart shows what has been accomplished in freight service on Class I roads with a relatively small number of modern locomotives

Generally speaking then, high-pressure steam seems to offer the most attractive means of increasing the efficiency of the reciprocating steam locomotives of today, and it may be expected to gain in importance very rapidly.

One of the chief difficulties in high-pressure steam generation is the maintenance of boiler efficiency, which tends to decrease with an increase in pressure, owing largely to the greater-temperature head required for the generation of high-pressure steam, which would naturally result in higher smokebox temperatures. We have the decreased boiler efficiency opposed to the increase in engine efficiency. The combination must be carefully analyzed if we are to effect an appreciable net saving of any amount.

How high will pressures go?

Just how far we shall go with high-pressure steam is very indefinite at the present time. While stationary plants have gone to the critical point of steam generation, which is about 3,200 lb. per sq. in., it is not likely that this will be done in locomotive service for some time to come, and it would appear at this time that somewhere between 1,000 and 1,500 lb. is as far as it is economical to go. In fact, 1,000 lb. will probably be sufficient for locomotive service unless some new development appears.

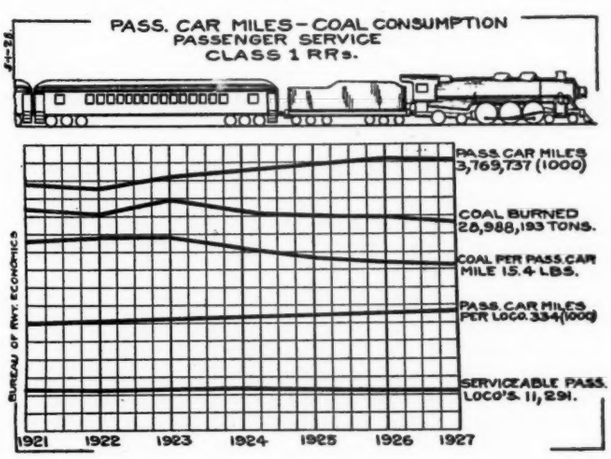
In the near future, we may expect to see experimental locomotives operating with boiler pressures up to 1,000 lb., with three cylinders, probably compounded; with water-tube fireboxes using coal fuel burned on grates; with improved draft apparatus and developing up to perhaps 7,500 i.hp.; with a steam consumption in general service, not exceeding 14 or 15 lb., and with a coal consumption probably less than 1½ lb. per i.hp. If this cannot be done, it would hardly seem worth while to go to the necessary complication and expense.

Present possibilities

The big savings to the railways, however, will come with the scrapping of their present obsolete power, the handling of freight in through maximum-tonnage trains, through grade reduction in double tracking, together with the elimination of all possible standby losses. In other words, to obtain maximum efficiency we must operate the machine, as a whole, at maximum capacity and continuously in order to obtain low-unit costs. This will result in fewer locomotives numerically, but engines much more powerful and better adapted individually to the particular service in which they will be used.

We have still to contend with the human element. Probably nowhere else in the whole railroad system is close understanding and co-operation of more vital importance than in the cab of the modern locomotive. Without this the efforts of the designer or the executive toward fuel economy are of little avail. We must share largely all past and future fuel credits with the engine crew direct, as well as with those responsible for their supervision and instruction as to the proper use of fuel.

The first chart shows us what has been accomplished



Passenger car miles and coal consumption for passenger locomotives on Class I roads

in freight service on Class I roads through organization and a relatively small number of strictly modern locomotives. Note that the number of serviceable freight locomotives varies very slightly from year to year, while the total number of gross ton-miles is rapidly rising, having increased about 40 per cent between 1921 and 1927. In spite of the rapidly increasing gross ton-miles, the total coal burned has remained nearly constant for the past few years. The coal per thousand gross ton-miles has decreased nearly 20 per cent in the past few years. It is to be hoped that this figure will continue to decrease at about the same rate for some time to come, although this is doubtful with present equipment.

The second chart shows us a similar situation in passenger service on Class I roads and repeats the

showing made in freight service, only to a more limited extent.

Fortunately, no finer body of men exist today as a whole than is found in the mechanical department of any large railroad. The railroads may, then, be assured that all possible economies owing to the use of modern locomotives are obtainable—all that is necessary is the modern locomotive itself.

The evolution of freight power

Let us take a concrete case, illustrative of conditions existing on practically all large railroads today. The road selected for illustration is typical of many systems in so far as its motive power is concerned.

This road, in common with most other large roads, about 1903 to 1908, standardized on a 22-in. by 32-in., 2-8-0 type locomotive with 63-in. wheels, having about 42,000 lb. tractive force. This was the usual design of first line freight locomotives at this time. It has a weight on drivers of 179,000 lb. and a total weight of a little over 200,000 lb. It was of the simplest design having slide valves, Stephenson gear, and, of course, used saturated steam. Many of these locomotives are still running today on lines of secondary importance, although most of them have been modernized to the extent which their condition has justified, with superheaters, piston valves and outside valve gear as they have gone through the shop for heavy repairs.

Next came the 2-8-2 type locomotives built for heavy road service as a successor to the previous 2-8-0 type. They have 28-in. by 32-in. cylinders, 63-in. wheels and a tractive force of 57,500 lb., with a weight on drivers of 236,000 lb. and a total weight of 318,000 lb. This means an increase of over 30 per cent in the driving axle limitation and slightly over 50 per cent in total weight. Such locomotives were built originally about 1912, and, of course, have increased gradually in size and efficiency up to the last purchase about 1924 or 1925. The 2-8-2 type, up to the limit of its capacity, has always been one of the most successful wheel arrangements used in general freight service.

This road like most systems, has one or two particularly hard divisions of undulating profile, over which four-coupled axles are insufficient to handle the full-tonnage trains. Hoping to overcome the difficulty, this road purchased for use on this division some of the earliest and most powerful 2-10-2 type locomotives built. They have 31-in. by 32-in. cylinders, 63-in. wheels and 83,000 lb. tractive force, with a weight on drivers of 339,000 lb. and a total weight of 420,000 lb. In this case the driving axle loading is increased something over 15 per cent and the total weight a little over 30 per cent. These locomotives were purchased from 1916 to 1918 and may be considered as being adapted only to the comparatively slow-operating speeds general at that time.

In order adequately to meet present-day conditions, this road purchased in 1927, a 2-8-4 type, having 28½-in. by 32-in. cylinders and 70-in. driving wheels, instead of 63-in, as heretofore, and a tractive force of about 70,000 lb. With the trailer-truck booster, this is increased to about 82,000 lb., or virtually the same as the 2-10-2 type which they supersede. They have a weight on drivers of 276,000 lb. and a total weight of 443,000 lb.

The driving axle load remains about the same, but the total weight has increased about five per cent over the 2-10-2 type. Virtually the same starting force has been obtained as on the five-axle locomotive, at the same time using a driving wheel 10 per cent greater in diameter. This means increased ton-miles per hour with decreased maintenance. The power output is considerably greater, largely because of improved general design and accessories. The four-wheel trailer truck has proved remarkably successful and provides a very steady riding engine. The large capacity tender facilitates continuous movement.

How the modern locomotive compares with its predecessors

Operation over a division which has a length of about 114 miles, with limiting grades approximately one per cent, both east and west, averaged about as shown in the table.

Operating results of a 2-8-4 type compared with a 2-10-2 type

	2-10-2	2-8-4	Difference per cent
Tonnage	2,443	2,720	+10
Coal per 1,000 gross ton-miles	134 lb.	94 lb.	—30
Running time	7—11	4—33	—35
Gross ton-miles per hour	38,800	68,150	+75.6
Gross ton-miles, total	[illegible]	310,080	+10
Coal fired per trip	37,320 lb. / 18.6 tons	29,140 lb. / 14.6 tons	—22

Assuming that a 25-day month and one round trip per day, 288 miles, we obtain a mileage per month of about 5,700. Assuming this to be obtainable with either type, bearing in mind that, owing to the increase in actual tonnage obtainable, 30, 2-8-4 type locomotives have replaced 34, 2-10-2 type on this division, the relative coal consumption per year will be 379,400 tons for the 34, 2-10-2 type locomotives, and 262,800 tons for the 30, 2-8-4 type locomotives—a difference of 116,640 tons. Assuming an average cost per ton of $3, the actual saving in fuel alone on this one division, brought about through the use of these new locomotives, is approximately $350,000. There will be further savings, incidental to the use of 30 instead of 34 locomotives of about $90,000 a year. This brings up the total yearly saving on this division to about $440,000.

As a matter of fact 50 locomotives of the 2-8-4 type were purchased in 1927, the remaining 20 being allocated to other divisions. It is expected that these 50 locomotives will show a total yearly saving in operating cost alone of between $650,000 and $700,000.

Bearing in mind the fact that the average active life of a locomotive is not far from 20 to 25 years, depending on the road and, furthermore, that our present high powered locomotives with comparatively low fuel consumption have only been in general use for perhaps less than five years, we may safely assume that conditions similar to those cited above are to be found on practically all the roads in this country today to the extent that the coal consumption of probably 66 2/3 per cent of the locomotives in daily freight service could be improved about 30 per cent, based on gross ton-mile performance.

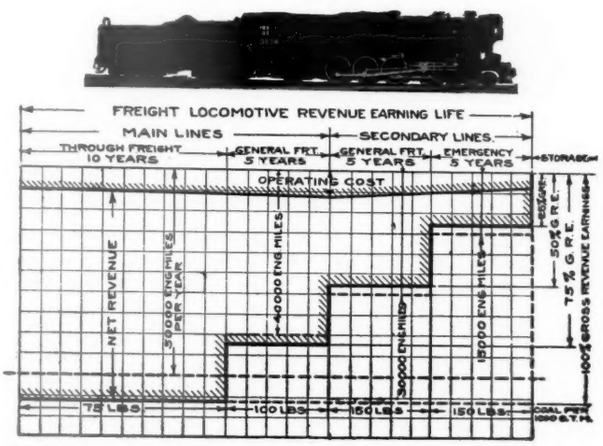
The possible saving would be 30 per cent of 66 2/3 per cent of 80,416,000 tons, or 16,083,000 tons. Assuming the average price per ton over the whole United States as $3.50, this means a possible yearly saving in fuel alone through the modernization of all freight power of approximately $56,291,200. This figure is obtainable through the co-operation of the railway organization and the locomotive builder.

Leaving the locomotive builder out of the picture for the moment, we find that in 1927, the average coal used per thousand gross ton-miles Class I roads was 131 lb. For the year 1926, this figure was 137 lb.,

or a saving of a little under five per cent, equivalent to $14,072,800, or about one quarter of the figure indicated by use of modern locomotive equipment throughout in freight service.

The life of a freight locomotive

The last chart presents a picture of the revenue life of the average main line fast freight steam locomotive, which is here considered (for example only) as being from 25 to 30 years. If properly maintained and operated under the same conditions, the revenue capacity of any locomotive in gross ton-miles, should remain fairly constant during its active life. Unfortunately for the locomotive, however, past experience has shown that new types of improved motive power have come into general use about every ten years, which limits the maximum productive life of any new locomotive to 10 years. At the end of this period, following the installation of the later improved power, the locomotive is set back to drag and emergency service on the main line, with a probable reduction in gross ton-mile capacity of at least 25 per cent.



Revenue earning life of freight locomotives in main and secondary line service

This period may be expected to last perhaps five years at the end of which the locomotive is again set back, owing to the purchase of additional new locomotives to general service on secondary lines, with a further reduction in gross ton-mile capacity of at least another 25 per cent. This service on secondary lines may last another five years, or may be prolonged to ten years, if conditions warrant. It is probable, in any event, that the final five years of the locomotive's existence will be spent in storage with occasional emergency use, giving a return of not over 25 per cent of its original gross ton-mile capacity. Note the increasing coal consumption per 1,000 gross ton-miles and the decreasing mileage with each setback.

If the secondary lines are too light to take the engine under consideration, the third period will be omitted and the final one extended.

Is the economic age limit exceeded?

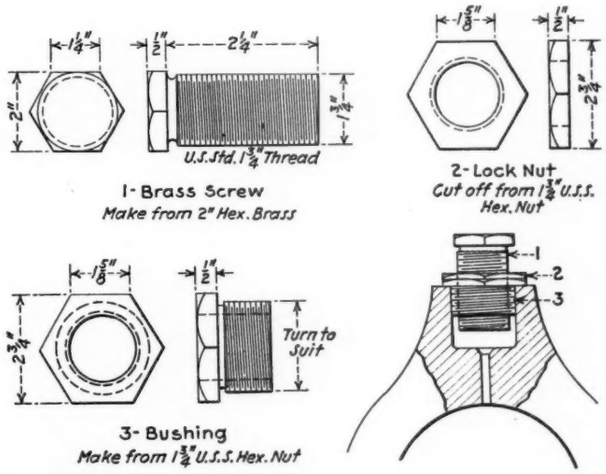
It will be seen then that approximately 50 per cent of the total work done during the 25-year life of the locomotive, has been done during the first third of its existence. Probably two-thirds of its total net revenue return is made during this time.

Can there be any plainer illustration than this to show the economic necessity for wearing out the locomotive in the service for which it was originally designed and the immediate scrapping when this has been accomplished, as would be done with any machine tool in a modern quantity production plant? How are we to justify the relatively heavy and rapidly increasing maintenance and operating costs on an obsolete piece of equipment, operating at perhaps 50 per cent capacity, under conditions for which it was never intended?

Grease cup cap for running repairs

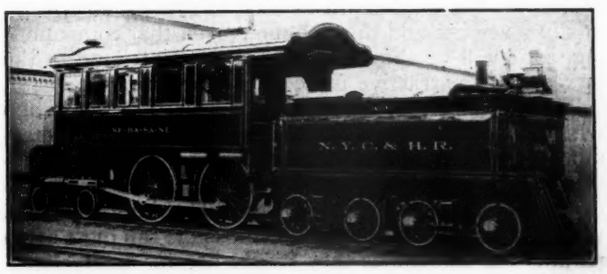
By H. H. Parker, Jr.
Shop draftsman, Norfolk & Portsmouth Belt Line, Portsmouth, Va.

QUITE often a locomotive completes a run minus one or more rod grease cup caps. When this occurs, especially at outlying points from which the locomotive has to double back, it is necessary for the machinist to turn out a quick job. In order to solve this occasional difficulty, the rod grease cup cap shown in the sketch, was developed on this road. It can be made in about 20 min. on a small engine lathe from a piece of 2-in. hexagon brass, ¾-in. long and two 1¾-in. hexagon nuts. The only work necessary is to turn down and chase the standard 1¾-in. thread on the piece of brass and to turn and chase threads to suit on the outside of the nut. This makes a strong and durable grease cup cap and at the same time is easily made and inexpensive.



A strong and inexpensive grease cup cap which can be quickly made in an emergency

* * *



A reminder of the days of 1900—An old 4-4-0 type rebuilt for inspection purposes on the N. Y. C. & H. R.

Attempts to increase steam locomotive efficiency

A review of the progress attained up to the present time, and of recent developments

By A. I. Lipetz

Consulting engineer, American Locomotive Co., Schenectady, N. Y.

Part I

THREE questions are to be considered in the development of the steam locomotive: the first is operating ability, the second is power, and the third is efficiency. A locomotive must first of all suit the purpose of pulling trains safely and reliably. The most up-to-date and technically perfected but complicated locomotive, for example, a locomotive with efficient modern turbines, high pressure boilers, high vacuum condensers, etc., would be of little use, if it should happen to have frequent breakdowns. The locomotive must be sound as a mechanism. Stephenson's "Rocket" had the advantage over all other locomotives previously built by Trevithick, Murdoch, Blenkinsop, Hedley, Stephenson himself and others, namely; that it was the first sound locomotive. After it had been established by Stephenson as a suitable mechanism a hundred years ago, the aim was accomplished and the first period of locomotive development was completed.

The development of the locomotive within the second period, which covers the following 75 years was mostly enlarging the size and power without essential modifications in the design. It is true that the efficiency of the locomotive was also improved during this period, but this happened, so to speak, incidentally, as the cause of it was the increase in boiler pressure from 50 to about 200 lb. per sq. in., required by the increase in power. It is further true that attempts to increase the locomotive efficiency were conscientiously made during the last 25 years of the second period in the form of application of the compound principle. This was done mostly in Europe and partly in the United States, but these attempts, at least in this country, were finally given up, and this for the reason that compounding, as it will be shown later, did not contribute to the increase of the tractive force of the locomotives.

The third period, which started about 25 years ago with the advent of the superheater is a period of determinded attempts to improve the efficiency of the locomotive without relinquishing, however, the acquired tendency of increasing their power. The improvements, with respect both to power and efficiency, ran most often parallel but sometimes they would become interrelated. For the sake of uniformity we shall consider here only efficiency, touching on power insofar as its increase has been influenced by efficiency.

The first locomotives built by Stephenson previous to the "Rocket," (the so-called Killingworth locomotives) were developing from 7 to 10 i. hp.-hr., and the coke consumption was about 30-40 lb. per i. hp.[1] Assuming that the heat value of coke was 14,500 B.t.u., the efficiency of those locomotives was .44 to .59 per cent. The consumption on the "Rocket" amounted to 18-20 lb. of coke per i. hp.-hr.[2]; the efficiency thus was .88 to .98 per cent. In 1834 Count de Pambour made tests with several locomotives built by Stephenson of the Planet and similar types. The power of these engines was between 30 and 70 i. hp. The coke consumption was from 8.0 to 14.5 lb. per i. hp.-hr.[3] The efficiency was, therefore, 1.21-2.2 per cent.

The boiler pressure in these locomotives was between 50 and 70 lb. per sq. in. Since then the pressure was continuously going up, until at the beginning of this century it reached 205 lb. in simple expansion locomotives, and 225 lb. per sq. in. in compound locomotives. When the building of compound locomotives was discontinued in this country, in some quarters it was thought advisable to go back to lower pressures, as the simple-expansion locomotives, it was argued, did not need high pressures. It was contended that a moderate pressure of about 180 lb. per sq. in. would permit within the same limits of weight a larger boiler, and that the increase of the evaporative capacity and efficiency of such a boiler would be equal to the gain which might result from the use of higher pressure.[4] Another reason for advocating the lower pressures was the desire to reduce the wear of boilers and fireboxes. Several attempts to lower the boiler pressure were made, but they were unsuccessful, most probably for the reason that the railroads had already discovered the advantages of higher pressures.

In 1868 tests were made on the Pennsylvania with freight engines carrying 150 lb. pressure. They showed

THIS is the first of two articles by A. I. Lipetz, consulting engineer, American Locomotive Company, Schenectady, N. Y., and also non-resident professor of locomotive engineering at Purdue University, Lafayette, Ind. These articles are summaries of two of a series of lectures delivered by the author, November 7 to 11, 1927, before a group of railroad officers, the senior students and the engineering faculty of the university. The lectures were profusely illustrated by slides, a few of which are reproduced in these articles. Although the material covered in the lectures has been somewhat abridged in these articles, new information has been added by the author to bring the subject up-to-date.

[1] Locomotive Engineering, by Zerah Colburn, Glasgow and New York, 1871, p. 30.
[2] Locomotive Engineering, pp. 26-28.
[3] Locomotive Engineering, pp. 34-37.
[4] High steam pressures in locomotive service, by Prof. Dr. W. F. M. Goss, Bulletin 26, Engineering Experiment Station, University of Illinois.

a consumption from 4¼ to 5¼ lb. of bituminous coal, presumably of 13,500 B.t.u. calorific value, per i. hp.-hr.,[5] or an efficiency of 3.6 to 4.5 per cent. Later, in 1904, a Pennsylvania 2-8-0 type locomotive with 205 lb. pressure was tested on the testing plant of the Louisiana Purchase Exposition at St. Louis, Mo., and showed a fuel consumption of 2.91 to 5.40 lb. of coal of about 14,200 B.t.u. per hp.-hr.[6], corresponding to 3.3 to 6.2 per cent. Another simple-expansion 2-8-0 type locomotive of 200 lb. pressure was tested at the same time on the testing plant and a similar fuel consumption was found, viz.; from 3.10 to 5.14 lb. per i. hp.-hr.

Several compound saturated steam locomotives were also tested on the testing plant in St. Louis and the following fuel consumptions were obtained:

1—For a tandem-compound 2-10-2 type locomotive of the A. T. & S. F. with 225-lb. pressure; 2.39 to 3.37 lb. i. hp.-hr., corresponding to 5.0 to 7.1 per cent efficiency.

2—For a cross-compound 2-8-0 type locomotive of the Michigan Central with 210-lb. pressure: 2.01 to 3.82 lb. i. hp.-hr., corresponding to 4.5 to 8.5 per cent efficiency.

3—For a four-cylinder balanced compound locomotive of the 4-4-2 type, de-Glehn system, similar to the standard high-speed locomotive of the Northern Railway of France, carrying 225-lb. pressure: 1.94 to 4.10 lb. of coal per i. hp.-hr., corresponding to 4.1 to 8.8 per cent efficiency, and

4—For a 4-4-2 type, four-cylinder Cole compound locomotive, carrying 220 lb.; 2.17 to 4.04 lb. of coal for i. hp.-hr., corresponding to 4.2 to 7.8 per cent.[7]

Modern locomotives with superheaters and feed water heaters give fuel consumption figures from 1.9 to 4.2 lb. per i. hp.-hr.[8], and sometimes even below 1.9 lb. This means an efficiency of 4.6 to 10.2 per cent. Now it is getting more and more difficult to raise the locomotive efficiency as is the case with every function when it approaches its maximum.

The above given efficiencies are referred to indicated horsepower; they are thus equal in each case to the product of the boiler efficiency and the engine efficiency. If the overall efficiencies should be considered, the above efficiencies must be further multiplied by the corresponding machine efficiencies.

[5] Locomotive Engineering, by Zerah Colburn, Glasgow and New York, 1871. p. 267.
[6] The Pennsylvania Locomotive Tests and Exhibits, 1905, p. 163.
[7] The Pennsylvania Locomotive Tests and Exhibits, pp. 362, 299, 427 and 651.
[8] The Pennsylvania Bulletin No. 32, 1924, p. 91.

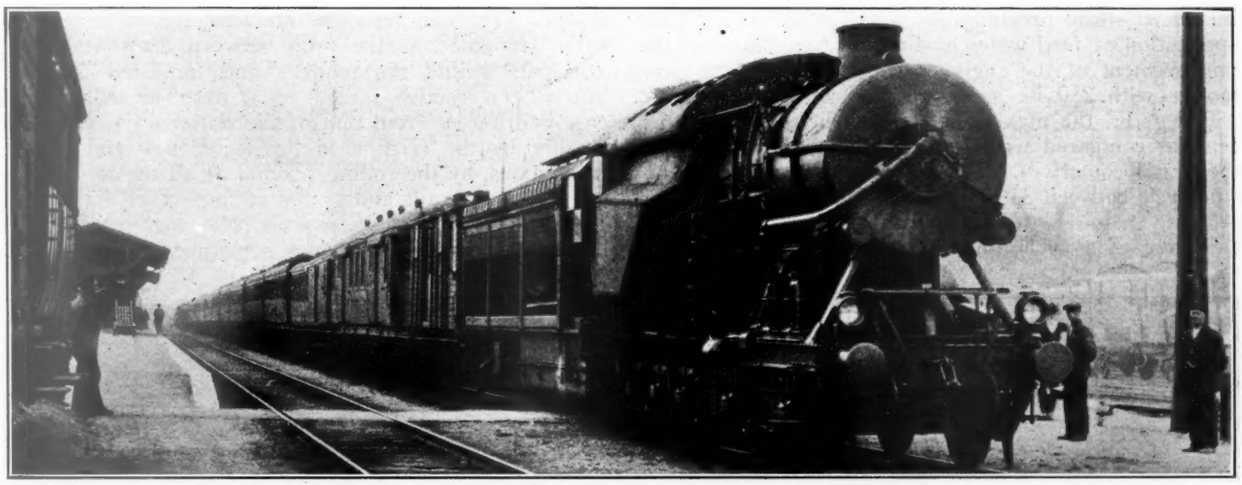
Boiler efficiency has almost reached its limit

As regards the boiler efficiency, it has almost reached its limit. Some recent tests have shown figures as high as, from 75 to 80 per cent for the efficiency of firebox, evaporating surface and superheater, not counting the feedwater heater. If we consider that the temperature of the exhaust gases cannot be much below 600 deg. F., a loss of heat through the smoke stack of at least 12 per cent is inevitable. Adding to this 2 per cent for radiation losses and assuming that the completeness of combustion can be brought up to 95 per cent, we obtain 81.6 per cent as a limit for the best boiler efficiency. We are not very far off in our modern locomotives.

It must be remembered, however, that these high boiler efficiencies are usually obtained at low firing and evaporation rates and that at high rates the boiler efficiency drops sometimes to below 50 per cent. While it is difficult to raise the boiler efficiency at low rates of firing above 75 to 80 per cent, it is still possible, by designing the boiler in accordance with the kind of fuel to be used, to improve the boiler performance at high rates of firing. In other words, to decrease the inclination of the straight line representing the boiler efficiency law. Much can be done in this respect even in modern locomotives.

I think it would not be amiss to touch here upon a certain misconception which has lately attained a widespread circulation. It has become customary to include the gain from feedwater heating in the boiler efficiency; the latter has been therefore, artificially inflated, in some instances to 89.5 per cent.[9] The incorrectness of such a computation is obvious: the gain is due to a partial condensation of the exhaust steam and to the recovery of a portion of the latent heat in the exhaust steam which otherwise would be lost. This has nothing to do with the boiler, as a device for extracting heat energy from fuel and transmitting it into water and steam. If water fed into the boiler is preheated by some external means, naturally more steam will be generated than in the case with cold water. If the same amount of heat units is liberated in the firebox, an equal amount of heat units will be transmitted in each of the two cases, as nothing has been changed in the boiler and the efficiency of the latter has thus not been improved.

[9] *Railway Mechanical Engineer*, October, 1925, p. 621.



The first Ljungstrom turbo-locomotive on one of its tests between Hagalund and Upsala on the Swedish State Railways —This shows the general appearance after it was rebuilt in 1923

The gain from feedwater heating should be listed separately, as this is being done in the Pennsylvania testing plant bulletins, or it should be included in the efficiency of the engine. The latter is low (about 13 per cent in the best modern locomotives) for the reason that a great amount of heat is lost with the exhaust. Therefore, if part of the loss is recovered, it should be placed on the credit side of the engine. In any event it should not be included in the boiler efficiency.[10]

The engine efficiency of the locomotive

The other multiplier, the engine efficiency, has been enormously increased from the time of the first locomotives, and especially within the last 25 years. As a matter of fact, all the improvements in locomotive efficiency, from the first Killingworth to the present day locomotives, have been made in the engine cycle. The raising of steam pressure, the use of superheat and the application of feed water heating, all contributed to the improvement of the engine cycle. In a modern locomotive with 250 lb. gage pressure with superheat to 650 deg. F., the maximum engine efficiency is 13 per cent, as compared with less than one-half per cent in the first locomotives. The efficiency of an ideal Rankine cycle between 250 lb. at 650 deg. F. and 6-lb. back pressure required for draft is 16.8 per cent. The efficiency of a cycle for the same admission pressure and temperature and with the same exhaust pressure, but with a 25 per cent cutoff, is only 14.8 per cent. While these efficiencies are really very low, the utilization of the ideal cycle, as can be seen from the above figures, has been well accomplished in the modern locomotive.

As regards the machine efficiency of the locomotive, which means the ratio of the power at the drawbar to the indicated cylinder power, it is fairly high—from 80 per cent to 90 per cent. Consequently, this cannot be appreciably increased. It is possible, though, that by using oil for lubrication instead of grease, and by applying roller bearings to locomotive and tender truck boxes, it could be slightly improved, but it is questionable whether the operating disadvantages of the former, and the complication of the latter, could be justified by the slight gain which might result from these means.

The above figures of machine efficiency have been taken from the Purdue University, and Altoona testing plants. The drawbar horsepower obtained during such tests is actually the power at the rims of the driving wheels. In road tests the machine efficiency is very often computed as the ratio between drawbar power (or pull behind the tender) and indicated cylinder power, (or tractive force). The drawbar pull in this case is different from that of the stationary plant; it is smaller by the friction in the locomotive and tender truck axles, by the rolling friction of all the locomotive wheels on the rails and by the air resistance. The difference is considerable, especially at high speeds, reducing the machine efficiency sometimes to 65 and 70 per cent. The two machine efficiencies should never be compared, as they have different meanings, unless the power behind the tender has been referred to the driving wheel rims by adding the friction losses."[11]

The latest design of Ljungstrom turbo-locomotive now in service on the Swedish State Railways

Turbo-locomotive for the Argentine State Railways ready for test at the works of Nydgvist & Holm, Trollhattan, Sweden

[10] Compare items 205 and 205a of the latest revision (1926) of the A. S. M. E. test code for steam locomotives.

[11] The A. S. M. E. test code for steam locomotives (1926) does not make this distinction—compare items 245 on pp. 12, 18 and 27 of the code.

The proper machine efficiency, which reflects the perfection of power transmission in the locomotive, is thus fairly high and offers very little room for improvement. Thus, there remains only the engine efficiency which may have something in store for the locomotive designer.

How to increase engine efficiency?

A good picture of an engine efficiency, at least for purposes of comparison, is offered by the ideal Rankine cycle between various admission and exhaust pressures. The table gives the efficiencies in per cent, of the Rankine cycle for admission pressures of 250, 500 and 750 lb. per sq. in. gage, at 700 deg. F. ultimate temperature of superheated steam, and with exhaust either into the atmosphere at 6 lb. per sq. in. gage, or into 28-in. vacuum, (about 1 lb. per sq. in. absolute).

Rankine cycle efficiencies for various initial and exhaust pressures

Back pressure	Admission pressure, 250 lb. per sq. in. gage	Admission pressure, 500 lb. per sq. in. gage	Admission pressure, 750 lb. per sq. in. gage
6 lb. per sq. in. gage (20.7 lb. absolute)	17.5	20.8	22.6
28-in. vacuum (1 lb. absolute)	31.0	33.8	35.3

Admission temperatures, 700 deg. F., in all cases.

It can be seen from this table that if we raise the pressure from 250 lb. to 500 lb. per sq. in., the ultimate temperature of the superheated steam remaining the same, the efficiency of the cycle is increased from 17.5 to 20.8 per cent, i. e., it is improved by 24.8 per cent. If on the other hand, the pressure and superheat remain unchanged (250 lb. at 700 deg. F.), but the exhaust is lowered from 20.7 lb. absolute to 1 lb. (28-in. vacuum), the efficiency will go up from 17.5 to 31.0, in other words, the cycle will be improved by 77 per cent. If both, the pressure is raised to 500 lb. and the exhaust is lowered to 28-in. vacuum, the efficiency will be raised from 17.5 to 33.8 per cent, or increased by 93 per cent.

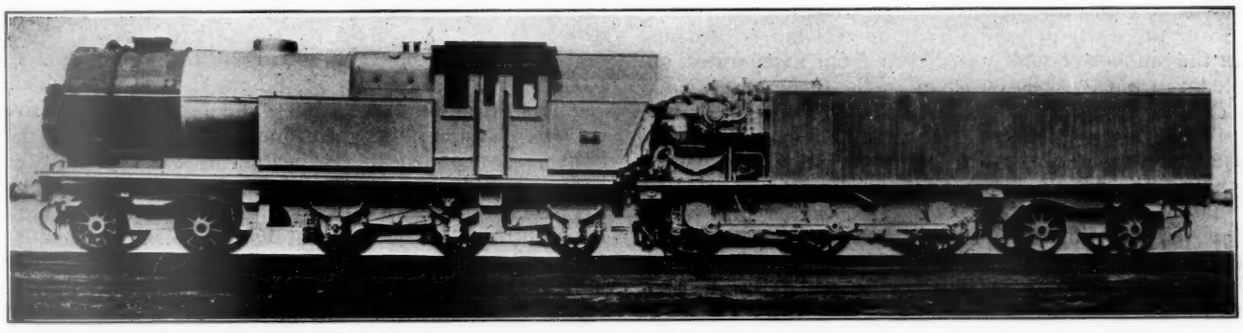
Thus we see that great possibilities are opened in two directions—in the raising of the boiler pressure and in the lowering of the back pressure, and that of these two the latter is even more tempting than the former. This explains why the problem of lowering the back pressure has been tackled first.

In order to obtain the low vacuum, it is necessary to add a condenser to the existing locomotive plant. This represents the first problem. Secondly, it is obvious that the reciprocating engine cannot be applied, for the reason that the specific bodies of steam at low pressures are so great that the low-pressure cylinders and exhaust pipes would become prohibitively large. Only a fairly high speed turbine could be made of such dimensions as to permit a convenient installation on a locomotive. The third question resulting from the second is the connection of the high speed turbine with the comparatively slow running driving wheels of the locomotive.

The development of the turbo-locomotive

In 1909 Reid, of the North British Locomotive Company, Glasgow, Scotland, designed and built a turbo-locomotive with a condenser. Very little has been heard of this locomotive, although it was operated for a time on the Cowlairs Incline, Glasgow, Scotland. (The Railway Gazette, November 11, 1927, page 581.) However, this gave rise to two other turbo-locomotives; one built by Ramsay, Mr. Reid's collaborator, in 1922, and another in 1924 by Reid, himself and McLeod, both of the North British Locomotive Company.

The two turbo-locomotives differed in the principles of the design; one had electric transmission, the other had gears. The Ramsay locomotive consisted of two units, each unit of the 2-6-0 type.[12]. The front unit carried the boiler, a 1,250-hp. turbine, an 890-kw. three-phase alternator coupled to the turbine, parts of the electric control and some auxiliaries; the rear unit, the condenser, and the rest of the auxiliaries and electric control. Each unit had two electric motors of 275-b.hp. geared to a jack-shaft which was coupled to the driving axles of each unit by means of rods. The most important part was the condenser which was of the evaporative type and of a peculiar rotary design. The exhaust steam passed into a slowly rotating drum consisting of small tubes. A tank with constant level water was placed underneath and the tubes were successively submerging in the water as the drum rotated. This was for the purpose of filming the tubes with water and of subsequent evaporation for condensing the exhaust steam inside the tubes. The evaporation was facilitated by a powerful motor-driven fan. It was figured on a vacuum of 27 in., but this could seldom be maintained; most often the vacuum had been between 20 in. and 24 in. It was never placed in regular service.



Turbo-locomotive built by Beyer, Peacock & Co., Ltd., Manchester, England

The design as a whole could not be considered a good railroad proposition. The 2-6-6-2 type locomotive, weighing about 300,000 lb., with a total length of 69 feet seven inches and a wheelbase of 59 feet 4 inches, had a tractive force of only 22,000 lb. at starting, and of 6,000 lb. at 60 m.p.h., thus developing a maximum output of 960 hp. The weight per horsepower was high—about 312 lb.

[12] Ramsay Condensing Turbo-Electric Locomotive, by George F. Jones and Lawrence Hale, Mechanical Engineering, April, 1925, pp. 235-239.

The Reid-McLeod locomotive is built along different lines, the boiler and the frame structure are supported by two eight-wheel trucks, each truck of the 4-4-0 type. Two turbines of 500 hp. each working on the compound principle are directly geared to the truck driving wheels.[13] The condenser is also of the evaporative type but stationary, and consists of vertical tubes connected by corresponding headers. The exhaust steam is directed inside the tubes, and a water filming device covers their outside surface. Air blown through by a fan evaporates the water and cools the exhaust.

The locomotive was exhibited at the Wembley Exhibition in London, Eng., in 1924. It was supposed to be sent for road tests immediately after the date of the exhibition, but nothing has been heard since.

The Zoelly turbo-locomotive

At the time of Ramsay's attempts to show some results with his turbo-electric locomotive, Dr. Zoelly, Chairman of the board of the Escher Wyss & Co., Zurich, Switzerland, in conjunction with the Swiss Locomotive Works of Winterthur, developed a turbo-locomotive, by rebuilding an old 4-6-0 ordinary locomotive of the Swiss State Railways, with its tender.[14] A six-stage impulse 1,000 hp. turbine of the Zoelly type for forward running, with a single compound wheel for running in the opposite direction, is placed crosswise under the smokebox. The turbine shaft is connected by a double reduction gear, with ratios of 1:7 and 1:4.1, with a jack shaft which transmits the power to the driving wheels by means of connecting rods.

Two water-cooled condensers of the surface type are placed one on each side of the boiler. The cooling water, after it has absorbed heat from the condensed steam, is cooled in a recooler placed on the tender. The recooler is of the evaporative type; it consists of series of parallel channels and perforated plates, the water is pumped into the upper channel and is gradually dripping down from one plate to the other. Air blown through in a counterflow by means of a turbine-driven fan, evaporates part of the water and thus cools very intensively the rest of it.

For the draft in the boiler, a special fan is provided in the smokebox which is driven from a separate live-steam turbine. At 1,500 r.p.m. of the turbine, a vacuum of 8.2 inches of water can be produced in the smokebox. In addition to this, there is a whole series of auxiliaries, such as a circulating water pump, air pump, condensate pump, etc., driven from another live-steam turbine rotating at 9,000 r.p.m. The feed water pipe is of the reciprocating type and is driven from the same turbine. The exhaust from the auxiliary turbines goes into the feed water heating system which is made so as to insure the highest economy.

Since 1921 the locomotive has been undergoing very exhaustive tests and alterations. During the tests valuable data have been collected. A great number of successful runs with trains were made. These road tests proved that the idea was sound and practical, but test data have not been published. An economy of 30 per cent was claimed for the locomotive, and it was alleged that on some occasions this had been proved.

Two other locomotives, constructed along the same lines followed, both in Germany; one was built by Krupp of Essen, and another by the Maffei Locomotive Works of Munich.

[13] The Reid-McLeod steam turbine locomotive, The Engineer, February 4, 1927, pp. 118-120.

[14] The Zoelly turbine-driven locomotive, by Dr. H. Zoelly, Mechanical Engineering, November, 1924, pp. 653-660.

The Krupp 4-6-2 locomotive is very similar to the Zoelly locomotive, but is of a much larger size.[15] The turbine for forward running is of the Zoelly type and has a 2,000 hp. output. The turbine for backward running is separately built. The condensers are of a greater capacity and the recooler is considerably increased. The locomotive was completed in 1924 and exhibited at the railway exposition of that year in Seddin, near Berlin, Germany, where it was making occasional short runs, without load. The vacuum at this low load was very good, the recooler seemed to be very efficient, if judged by the amount of vapor emitted from the top of it. Since then the locomotive has been continuously tested on German railways, but some minor details had to be adjusted before the locomotive could be placed in regular service. By the middle of 1927 this was not done, and no further information has become available since.

The Maffei turbo-locomotive

The Maffei locomotive is likewise of the 4-6-2 type.[16] The forward 2,000 to 2,700 hp. turbine and the slightly less powerful turbine for backward running are located in one housing. The turbine shaft is connected to the jack shaft by a double reduction gear with a ratio of 1:24 at the highest locomotive speed (74.6 m.p.h.) the turbine shaft makes 8,800 r.p.m. For the control of speed and tractive force, four nozzles are provided for each of the turbines. This insures high tractive forces at starting and fairly good efficiency at all loads. The locomotive has been designed for pulling heavy express trains at an average speed of 62 m.p.h.

The total weight of the locomotive in working order is 229,000 lb. or only 91.6 lb. per hp. The weight of the turbo-locomotive with the tender is 379,000 lb. or 4.5 per cent less than the standard Pacific type locomotive of the German Railways which is doing the same work.

Two surface condensers are placed longitudinally and are connected in parallel, The recooler is of the same type as on the Zoelly and Krupp locomotives, but of a slightly different design. Two horizontal fans are delivering 882.5 cu ft. per sec., at a speed of 1,000 r.p.m. and absorb 26 hp. The cooling water pump runs at 6,000 r.p.m. and delivers 12,380 cu. ft. per hour. This requires an additional 25 hp. The fans and pump are driven by an auxiliary turbine. Before entering the boiler, the condensate is heated in two feed water heaters by the exhaust steam from the feed-water pump, the air compressor, the two steam ejectors, and all auxiliary turbines, namely; that which drives the tender fans and cooling water pump, that of the dynamo for lighting purposes and the turbine of the induced draft fan in the smokebox. The latter has a speed of from 6,000 to 7,000 r.p.m. is made of special steel and has been designed in such a way as to insure cooling of its bearings by the frontal air when the locomotive is moving.

The boiler has a radial stay firebox and carries a pressure of 313 lb. per sq. in. The total evaporative heating surface is 1,720 sq. ft. in addition to the superheater which has a surface of 540 sq. ft. In a reciprocating type locomotive such a boiler would not develop over 1,250 hp.

The locomotive is now undergoing tests on German

[15] A new turbo-locomotive for the German State Railways, Railway Engineer, January, 1925, pp. 27-28. A more complete description can be found in Kruppsche Monatshefte, August and September, 1924.

[16] Turbine locomotive for the German State Railways by G. F. Melms, *Railway Mechanical Engineer*, February, 1927, pp. 78-84; also Zeitschrift des Vereines Deutscher Ingenieure, November 20, 1926, pp. 1565-1572.

railroads. Results are not yet known, but it has been estimated that the total overall efficiency, from the coal to the wheels, will amount to 15.6 per cent at a speed of 43.5 m.p.h.

The Ljungstrom turbo-locomotive

Quite independently from Ramsay and Zoelly, and along different lines the Ljungstrom Brothers, of Stockholm, Sweden, have been working since 1917. They developed an air-cooled condenser of a special design. It consists of a drum approximately in the center of the tender, or, strictly speaking, of the rear unit of the locomotive,[17] with flat ribbed tubes forming the roof of the tender. The tubes are made from ordinary brass tubes which are flattened and ribbed in special machines. The ribs of two adjacent tubes are placed at a certain angle in order to prevent close contact and leave sufficient space between tubes for the passage of cooling air. The tubes are brazed into special square boxes, or little headers, which merge into horizontal pipes connected with the drum. Thus the exhaust steam, cooled and condensed in the flattened tubes, collects in the lower portion of the drum, whence it is delivered to the boiler by means of a condensate pump and a feedwater pump. The total cooling surface of the condenser is approximately 10,700 sq. ft.

The cooling air is supplied by three large horizontal fans with vertical shafts directly driven by frictional wheels from the main turbine. The latter is mounted in the front part of the rear unit. The three fans deliver 4,230 cu. ft. of air per second, or 4.8 times as much as the Maffei turbo-locomotive, which is 66.7 per cent more powerful. For equal power the air-cooled condenser requires several times as much air as the evaporative condenser. The reason is obvious. In the air-cooled condenser of the Ljungstrom type the latent heat of the exhaust steam is entirely absorbed by the air, which must thus be considerably heated, whereas in the evaporative condenser most of the latent heat is absorbed by evaporation of a certain portion of the cooling water, and only the remainder of the latent heat is carried away by the heated air. The amount of air required in the second case is, of course, much less than in the first.

The air-cooled condenser has, nevertheless, the advantage that cooling water is not required at all, whereas in the evaporative condenser the evaporated portion of cooling water must be replaced. In hot weather the cooling effect of the air is negligible, sometimes nil, and, therefore, all the heat must be absorbed by evaporation. The amount of evaporated water is, roughly speaking, equal to the amount of condensed steam, multiplied by the ratio of latent heats at the pressure in the condenser and atmospheric pressure. For a 27-in. vacuum this ratio amounts to 1.06, which means that for each pound of condensed steam 1.06 lb. of make-up water is required. Thus assuming that a turbo-locomotive with 27 in. vacuum will require 35 per cent less steam than a reciprocating type engine, the consumption of water will be about 70 per cent of that in ordinary locomotives.

It would seem, therefore, that for countries where water is scarce, the Ljungstrom type of condenser should have a decided advantage over the evaporative type, provided that the weather in these countries is not too hot, as the effect of the air-cooled condenser drops rapidly with the rise in the air temperature. Unfortunately, arid countries are mostly located in the hottest zone of our globe. In the evaporative condenser hot air evaporates less water also, but it can carry away more moisture, as the saturation point of heated air is raised with the increase in temperature, consequently the effect of hot weather is less pronounced in the evaporative type of condenser than in the air-cooled type.

Therefore, for countries with moderate climate and hot weather in summer, if water is available, the evaporative condenser should be preferred. In cold climate the Ljungstrom type offers advantages in view of economy in water.

The Ljungstrom locomotive consists of two units.[18] The front unit carries the boiler, the induced draft fan, placed in the smokebox, the coal bunker, the air preheater of a special Ljungstrom design where the air for combustion is heated by the exhaust gases before it enters the firebox, three feedwater heaters connected in series, each fed by exhaust steam of different pressures from various auxiliaries, and some other appliances of minor importance. The unit is supported by a front four-wheel truck and six idling wheels placed in the main frame. The rear unit carries the main 1,800-hp. turbine geared to a jack shaft connected with three front driving axles by means of rods, and the condenser which was previously mentioned. This unit has in the rear a two-wheel truck.

The boiler is of the ordinary locomotive type, differing only in the length of tubes, which is 9 ft. 10 in., the object being to secure an exhaust gas temperature of at least 660 deg. F., in order to obtain an intensive air preheating. The boiler pressure is 285 lb. per sq. in. The total heating surface is 1,345 sq. ft. and the heating surface of the superheater is 861 sq. ft.

The induced draft fan is mounted on the top of the smokebox front. It is driven by a directly coupled turbine running at a speed of 10,000 r.p.m. All exhaust gases, cooled in the air preheater to about 370 deg. F., pass through the fan and are discharged into the atmosphere. This absorbs 40 hp.

The main turbine develops 1,800 hp. at 9,200 r.p.m., corresponding to a locomotive speed of 68.3 m.p.h. The tractive force and speed are controlled by varying the number of acting nozzles; four nozzles on grades and at starting and three for normal work. The transmission of power is made flexible and self-aligning and is accomplished through a double-reduction gear with a ratio of 1:22. The reversing is being done by disengaging the second gear drive and inserting an idle pinion; these manipulations are carried out hydraulically with lubricating oil under pressure.

The total weight of the two units of the locomotive is 282,000 lb., or about 157 lb. per hp. maximum turbine output.

Tests of the Ljungstrom locomotive on the Swedish State Railways

When the locomotive was designed, every detail of a more or less new nature was first thoroughly tested in a specially built laboratory, either in full size, or in a reduced size model built to scale. All auxiliaries and their parts were tested in the laboratory, and later, when the locomotive was completed, it was tested on rollers with dynamometer brakes. Thus the proper performance of the locomotive, as a whole, and of its details and auxiliaries was tried and perfected. After four months' tests the locomotive was turned over to the Swedish State Railways where it has been running

[17] Engineering, August 11th, 1922, pp. 163-168.

[18] Engineering, July 21, August 4 and 18, 1922, pp. 64-70, 131-133 and 198-203.

experimentally for the last several years. The majority of the runs in 1921 to 1923 were made with a dynamometer car and a great deal of experimental data were thus collected. The starting was always very smooth, no excessive trouble or breakdowns have been experienced. On these runs the locomotive would pull passenger trains weighing up to 600 short tons over a district between Hagalund and Upsala with several one per cent grades, with an average speed of 40 m.p.h., occasionally reaching a speed of 58 m.p.h. The vacuum would fluctuate between 24 in. and 27 in. and the average fuel consumption amounted to 2 lb. per drawbar hp. hr. Per 1,000 ton-miles it was 63.6 lb. which, it is claimed, is about one-half of the coal consumed on passenger trains over the same district with regular Swedish passenger locomotives.

Since 1923 a similar locomotive with a 2,000 hp. and 300-lb. boiler pressure turbine has been built in Sweden for the Swedish State Railways, and another locomotive of approximately the same power for the meter gage railways in Argentine.

The new Swedish locomotive's wheel arrangement is similar to that of the first Ljungstrom locomotive, differing only in that it has in the rear a four-wheel instead of a two-wheel truck, the rear unit being of the 0-6-4 type, while the Argentine locomotive's rear unit has four driving axles and a two-wheel truck, (an 0-8-2 wheel arrangement). The front units are in all three locomotives of what one might call the 4-6-0 type, although there are no drivers in this unit.

The Argentine locomotive is oil-fired, weighs about 270,000 lb. and is able to pull 560 tons over a comparatively hilly profile with a maximum speed of 41 m.p.h. The Ljungstrom Company has guaranteed a saving of at least 50 per cent in cold weather and 40 per cent in hot weather, as compared with ordinary locomotives doing similar work.[19]

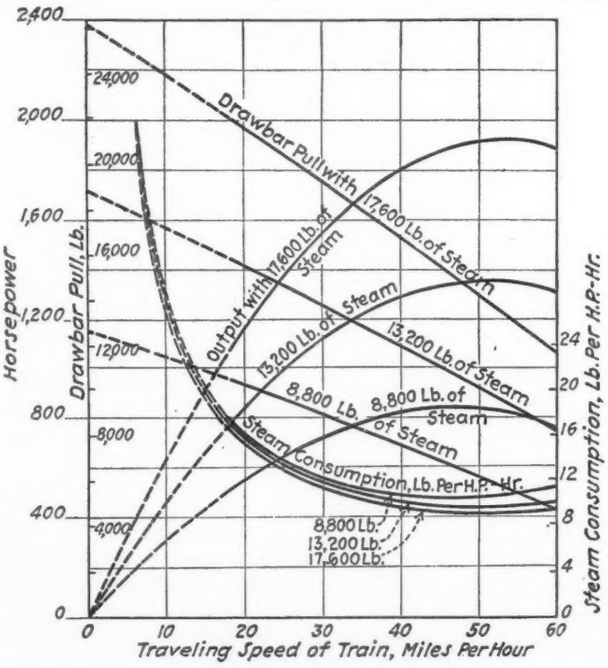
In November, 1926, a slightly modified Ljungstrom locomotive was completed by Beyer, Peacock & Co., Manchester, England, with the same wheel arrangement as the second Swedish locomotive referred to in the preceding paragraph.[20] Last July this locomotive was placed in regular service on the London, Midland & Scottish Railway. The main turbine develops 2,000 hp. at a speed of 10,500 r.p.m., corresponding to a locomotive speed of 75 m.p.h. The cooling surface of the condenser is larger than in the first Swedish locomotive—13,500 sq. ft. There are four fans instead of three, driven from an independent turbine; the speed of the fans can be controlled by the engineman. The gear drive from the turbine is slightly modified, the last gear driving the first axle by means of a quill and links, from which by means of outside cranks and rods the intermediate and rear axles are driven. The smokebox air preheater is of a novel design; draft fan is driven at a speed of 6,000 r.p.m. through a reduction gearing from a small turbine rotating at 30,000 r.p.m.; some changes have been made in the feed water heating arrangement and auxiliaries.

Thus there are now in Europe several passenger turbo-locomotives, of which the latest two, one built by Maffei, and the other, built by Beyer, Peacock & Co., represent the two possible types; with the evaporative and with the air-cooled condenser. The performance of these turbo-locomotives in actual service will be of great value for the determination of lines along which the future perfection of the turbo-locomotive is possible.

[19] Engineering, May 11, 1923.

[20] British Ljungstrom turbo-condensing locomotive, The Railway Engineer, July, 1927, pp. 261-262, and p. 247.; also Engineering, December 16 and 23, 1927, pp. 771-774 and 801-804.

The Zoelly and Ljungstrom turbo-locomotive types have, though, one feature in common—the gear transmission between turbine and wheels. The speed of the turbine is thus in direct proportion to the locomotive speed. As it is known, the highest efficiency of a turbine can be obtained at one speed only, which is usually chosen as the normal speed of the turbine. At all speeds above and below that speed the efficiency is less; it is especially low at low speeds. Consequently, in a steam locomotive with a direct connection between the turbine and driving wheels the steam consumption at starting and during acceleration periods, as well as on grades, will be considerably increased. This is evident from the chart showing the output, drawbar pulls, and steam consumptions for a Zoelly 2,000 hp. locomotive, as estimated by Dr. Zoelly himself.[21] It can be seen that steam consumptions which are low at speeds about 50 m.p.h. go up very rapidly with the drop in speed: for 20 m.p.h. they are almost twice and for 10 m.p.h.—three times as high as at 50 m.p.h. Steam consumption curves for locomotives with reciprocating engines also show a minimum at certain speeds, but they are usually flatter and the variation in speed does not affect the steam consumption to such an extent. Therefore, while at normal speed a turbo-locomotive may



Output, drawbar pull and steam consumption of 2,000-hp. Zoelly turbo-locomotive for different speeds and steam quantities

show a saving of 50 per cent as compared with ordinary locomotives, at other speeds the economy will be less. It is thus evident that this type of locomotive is better suited to through main line express trains than to ordinary freight trains with constant variation in speed and frequent stops.

Ramsay tried to overcome the difficulty by using a constant speed turbine and controlling the speed electrically, but this led him to many complications. Zoelly and Ljungstrom resorted to the more simple scheme of gear transmission, and tried to avoid the disadvantage of variable speed by using several nozzles and controlling the tractive effort in such a way as to obtain an

[21] The Zoelly turbine-driven locomotive, Mechanical Engineering, November, 1924, p. 658.

almost constant speed. This can be done only within certain limits, as otherwise a very large size boiler would be required.

There is another point to be borne in mind in connection with the turbo-locomotives, this is the sensitiveness of the steam consumption with respect to the vacuum in the condenser. A steam turbine designed for a certain vacuum is a more economical prime mover than a reciprocating engine with exhaust into atmosphere, but if the vacuum is not properly maintained, the turbine becomes very uneconomical. Dr. Zoelly figures that a drop in vacuum of one inch increases steam consumption by 1½ per cent. The vacuum is a very delicate thing: a small leak in the turbine glands, or in the condenser piping, or in the air injector, may lower the vacuum by 8 in. or 10 in. and thus reduce the economy from 12 to 15 per cent, sometimes even more. If for some reason the vacuum should break down, the turbine will become very wasteful, consuming more steam than the ordinary reciprocating engine of our present locomotive. This shows that all these appliances, as well as other apparatus on a turbo-locomotive, must be of a very reliable design and must be well maintained and attended to—a condition which is not always found on a railroad. However, it is within reason to believe that, as conditions improve, proper care will become a habit with railroads and that by the time, when there will be many turbo-locomotives to look after, their handling will offer no difficulties.

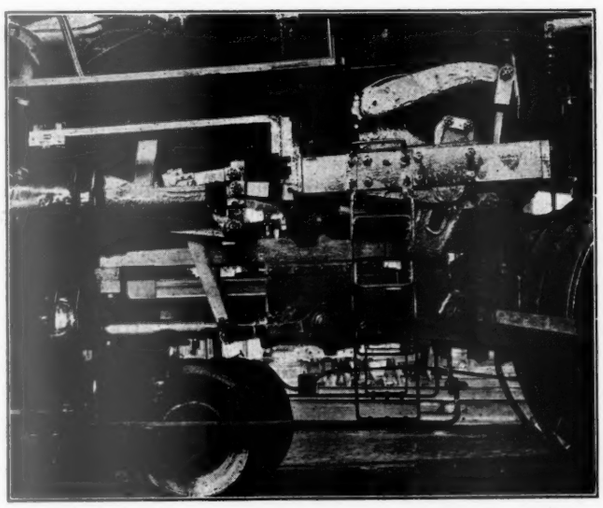
(To be continued in the August issue.)

Something new in Walschaert valve gear

By W. A. Franklin

THE device shown in the illustration is an addition to the standard form of Walschaert locomotive valve gear which effects an increase in travel from 5 in. up to 9 in., using the same combination lever and eccentric crank throw as used for the shorter travel. The advantage of long travel is recognized. It gives a wider and quicker port opening, and sufficient port opening near the dead points of the stroke to make starting easier. The device is called the "starting power lever," and consists of a short vertical lever, pivoted at a point below and back of the valve stem crosshead, and the necessary link to connect this lever to the top end of the combination lever. It is being applied to a number of locomotives on a large railroad as they pass through the shop and are changed from balanced compound to simple engines.

Referring to the illustration, the power starting lever acts as a lever of the third class and increases the eccentric crank increment of the motion a considerable amount before it reaches the combination lever. The bad effects of increasing the valve travel by using an excessively large eccentric crank throw are well known to designers of Walschaert gear. The high angularity of the parts necessary to give a 9-in. travel introduces certain irregularities or errors in the motion effecting the point of cut off, that are difficult to compensate or overcome. In designing a Walschaert gear the link foot pin center should be located low enough so that it will swing tangent to a line not over 3 in. above a line through the axle centers. To keep within this limit the link pivot is usually placed below the valve center line, and the radius rod will necessarily be inclined when in the mid-gear position (in good design not to exceed 1 in 12). The power starting lever lowers the front end of the radius rod connection and makes the radius rod approximately level when in mid-gear.

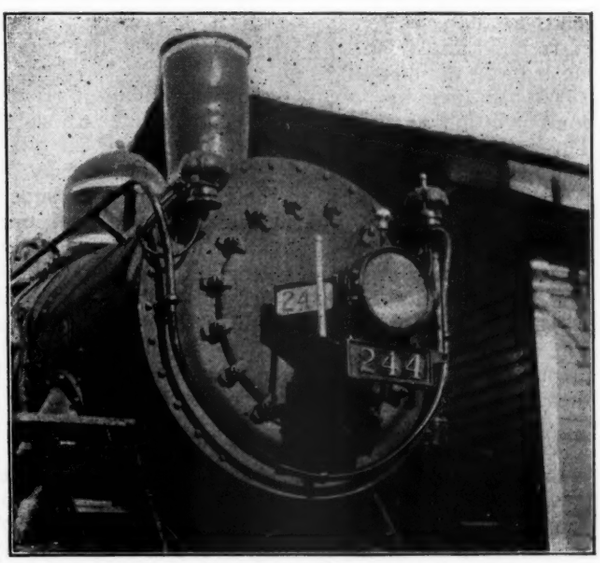


The "starting power lever" is pivoted at a point below and back of the valve stem crosshead and is linked to the top end of the combination lever

RADIAL DRILLING MACHINE.—An 8-ft. radial drilling machine, especially suitable for all classes of drilling, boring, tapping and studding in connection with the construction of heavy machinery, is described in the 8-page bulletin of William Asquith, Ltd., Highroad Well Works, Halifax, England.

WEAR AND MACHINABILITY OF CAST IRON.—Data on the wear and machinability of cast iron as prepared by Thomas H. Wickenden for the Journal of the Society of Automotive Engineers, are contained in the eight-page bulletin, No. 206, of the International Nickel Company, 67 Wall street, New York.

* * *



An Atlantic Coast Line locomotive equipped with a pressed steel front end door—These doors are formed hot in cast iron dies

Car and operating department co-operation*

Being an earnest appeal for car men to do their part in securing "adequate, expeditious and dependable" service

By F. J. Swanson

General car foreman; Chicago, Milwaukee, St. Paul & Pacific, Chicago

IN 1927, bad order cars showed a reduction of 5.9 per cent over the previous year. These figures can be greatly reduced by car inspectors making a closer inspection of all freight car equipment, whether in interchange movement or in the transportation yards, to determine whether the cars have any old defects, such as broken draft bolts, draft arms, center sills or channels, couplers or parts, brake-rigging, arch bars, wheel or truck parts, defective air brakes, etc. These, in many instances, cause derailments in the yards or enroute and also cause the pulling out of draft gears, which all tends to add new breaks or defects, increasing the cost of freight train repairs and also destroying and wrecking a large number of cars.

We also have the so-called rough handling of freight equipment in our transportation or train make-up yards. The car inspectors, safety appliance men and car oilers can be of great help to the operating department by reporting any yard damage to the car foreman or supervisor in charge, giving the track location and yard, time of day it occurred, engine number, name of conductor or foreman in charge of the engine that damaged the cars, as it is found that considerable damage is done in all railroad yards, especially side swiping or cornering. The operating department is always glad to receive this information so that it can then take up the matter with those responsible for proper correction.

Watch for damage in unloading

Large savings can be made if car inspectors will closely watch and report to their supervisors any case of damage that is done to open top cars by unloading of clamshells or unloading machines. It has been found in closely following up with the consignee or unloading concern, that they want to co-operate with us and discontinue the damaging of open-top cars with unloading machines.

Car oilers or box packers can help to reduce freight car costs by giving proper attention to journal box packing, journal bearings and trucks in general, and see that they are properly lubricated to aid in preventing hot boxes and cut journal conditions. Such conditions usually mean the changing of wheels which, in most cases, are still fit for further service. There is only one way to reduce freight car costs, and that is by all departments working closely together and co-operating to the fullest extent.

Car inspectors should make close inspection of equipment so as to catch old defects or flaws which are causing considerable trouble, and trainmasters and yardmasters should investigate all so-called rough handling or yard damages with the switchmen or trainmen responsible, explaining to them what expense it means to the railroad in the way of repairing equipment, fuel costs, switching costs, per diem delay in moving of freight to destination, reduction in car-mile haul and numerous other costs incidental to the damaging of equipment. A little personal interest and co-operation by all concerned will create a marked improvement.

Wheel defects need constant attention

When loaded cars are received from our connections, it is necessary many times to mark them bad order for our different repair tracks on account of worn-out wheels and necessary wheel changes. This increases the cost of car handling, decreases car-mile haul, increases per diem and, worst of all, delays the movement of freight, which, in many cases, means the loss of business. Then, too, we receive cars, as do other railroads, with old defects such as broken draft bolts, broken and

* Abstract of an address presented at the meeting of the Car Foremen's Association of Chicago, on May 14, 1928.

split center sills and draft timbers, broken draft arms and center channels, broken truck bolsters and cracked truck frames, and other such defects, which mean that the cars have to be marked to the repair tracks for repairs. In many instances, transfer of contents are necessary, all of which causes increase of freight car costs and decrease of freight car revenue. We are receiving here at Chicago in interchange movement from connecting lines an average of 21,000 and 25,000 loaded cars per month, these cars being mostly consigned to points on our line outside of Chicago and other connections, being loaded usually with high class freight. Out of this amount, it is necessary for us to mark an average of 300 to 350 cars monthly bad order to the repair track for wheel changes.

This condition can be greatly improved if the operating department and the car department work more closely together. For example, a great many cars are loaded at outside points where no inspectors or carmen are employed. Some of these cars carry old defects and are delivered to connecting lines which mark them bad order. Then again, a number of these cars have hidden or concealed defects which are not visible while the car is under load. These cars are unloaded by the consignee and the station agent or transportation department allows the concern that unloads these cars to reload them with the old defects uncorrected. This practice could be reduced to a great extent and suitable cars furnished if the operating department would notify the car department to have these cars inspected. Where no inspectors are employed, the agents should have proper instructions to inspect this equipment.

Inspect all cars before loading

Where empty cars are ordered for placing at the different loading platforms, freight houses and industries, the operating department should work closely with the car department to have the cars inspected before loading so that good order cars can be furnished. These are conditions that exist daily and can be reduced by close co-operation between the operating and the car departments. The old idea of passing the buck to the other fellow and letting him fix the car is not railroad economy or co-operation and only reduces business as a whole on all railroads.

Increased car miles can be obtained by allowing the car department sufficient time in which to inspect properly and put in condition all road or time-freight trains. By not having sufficient time, the result is that a considerable number of delays occur enroute because of hot boxes, trains parting, etc. By the yardmaster keeping the carmen fully acquainted ahead of time with what cars are going out, the track, location and time of departure, and then having the train made up in ample time to give it proper attention and air tests, road delays will be reduced.

The car department can assist the operating department in reducing damage claims by reporting promptly to the operating department all cases of rough handling, the largest claim factor. Cases of improper loading are another feature that should be closely watched by the car department employees. Any cases of improper loading, where the shippers are not complying with A.R.A. loading rules, should be reported to the proper authorities for correction; also, wherever possible, the car department should send a competent carman to the shipper and explain the correct method of loading according to A.R.A. rules.

Orderliness in the car department contributes much to efficiency and a high standard of car maintenance

Adequate inspection time absolutely essential

Delay in the moving of freight is an important contributing factor in loss and damage claims. The operating and car departments should work closely together in the moving of freight. The operating department should give the car department sufficient time in which properly to take care of the trains before their departure from terminal points. Car department employees should do their part by getting

the train out on schedule time, as a delay at the terminal point means faster running time out on the road, which may result in costly derailments, hot boxes and set-outs. Therefore, it is important that the trains be given a thorough inspection and proper attention at the terminal departure yards. A car set out enroute means an average loss to any railroad company of about $50.00.

The car department should inspect cars and give the necessary attention at freight houses, loading platforms, industry tracks, etc. wherever possible. A good inspection during the day time is worth double what can be given at night. Close inspections and proper repairs should be given all cars passing over the repair tracks.

Much delay could be avoided if proper inspections were made of all empty cars prior to loading. We now experience many delays of loaded cars on account of wheel changes and other old defects, and closer co-operation between the operating department and the car department is urged on all railroads as delays in the moving of loaded cars is costly in all respects and usually means a loss of business. A delay of over 24 hrs. in the moving of grain, in many cases, means the filing of a claim. A stock train delayed means loss of business and possibly the filing of a claim on account of a drop in the markets, and other reasons, such as shrinkages.

Do you load unfit cars?

All car department employees, especially the car inspectors and repair track checkers, must be thoroughly familiar with A.R.A. freight claim Rule 64*.

This is where considerable savings can be made in reducing defective equipment claims. Where no carmen are employed, station agents can be of great help and where the carmen are employed, the operating department should keep the car department fully informed regarding all orders being placed or cars wanted and to advise for what class of lading they are required. Car department employees and car inspectors should make close inspection of all empty equipment moving in interchange, in train yards or off of the repair tracks to see that they are properly marked and side carded for the commodity or class of loading for which the cars are fit. This aids the operating department in classifying the equipment properly, reduces the handlings, increases car days and car-mile haul and reduces the per diem.

Considerable savings can be made by close co-operation on the part of member lines or connecting lines which will reduce claims to quite an extent. In the Chicago Terminals district, better known as the Chicago Car Interchange Bureau district, during the year 1923, a total of 14,949 cars were transferred on account of bad order conditions; in 1926, this was reduced to 3,047 cars, and in 1927, to 1,775 cars, which is a very good reduction. It is quite true that better equipment has something to do with this, yet, I feel that it was brought about in a large measure through the co-operation and personal interest and hard work on the part of the Chicago Car Interchange Bureau organization, and the car department employees on all railroads in this district, which demonstrates what can be done with the proper co-operation.

End view of modern freight wood car shop

Empty order cars are being reduced

During the year 1923, it is estimated that a total of 14,000 empty order cars were returned by different connecting lines in the Chicago district; in the year 1926, the number of order cars was reduced to 650 cars, and in 1927, this was again reduced to 630 cars, which is also a good showing for all concerned. The returning of empty order cars is not creating revenue for any railroad, nor is it helping to increase business, as it only aggravates the shipper.

Modern, well-equipped shop which helps one western road keep its cars in good condition

* Section 3 (a) to (e) inclusive, of this rule relate largely to the inspection, cleaning and conditioning of empty cars before being placed for loading.

By proper co-operation, personal interest and common sense, a still better showing can be made on both items. Cars are being transferred now in the Chicago district, as well as at other points in this country, for defects that can be easily repaired under load, saving the cost of transfer and preventing the possibility of a claim. The defects which I refer to are such as slight cracks in cast-steel truck frames, cracked cast-steel truck bolsters and body bolsters, broken metal truck bolsters and other defects that can be repaired easily under load.

The car department employees can assist the operating department in reducing per diem by promptly repairing all foreign equipment found in bad order and also by all departments promptly unloading and releasing foreign cars loaded with company material. They can also assist the operating department by reporting any foreign cars standing on side tracks or some industry tracks that have been unloaded and not switched out. A delivery of a string of cars or train of 50 cars delivered from a foreign railroad back to a connecting line before midnight means a savings of $50.00 for this road. All railroad companies want their own equipment returned in order to reduce per diem or car hire, and per diem can be reduced by co-operation by all concerned.

Able and loyal car inspectors, a valuable asset

A competent, loyal and reliable car inspector is a valuable asset on any railroad. We men, as supervisors, should always co-operate with them; we should interest ourselves in their work, see that they are thoroughly familiar and instructed in all car department matters, fully acquainted with A.R.A. loading rules, Bureau of Explosive regulations and rules, and general safety appliance rules and instructions, so that they can get all the benefits from these instructions, improve their knowledge of car department work, and widen their understanding of railroad operations as a whole. A fully instructed car inspector or carman is, in most cases, good material to advance as a car foreman and farther up in the higher positions in the car department, and they deserve all the aid and encouragement which can be given to them.

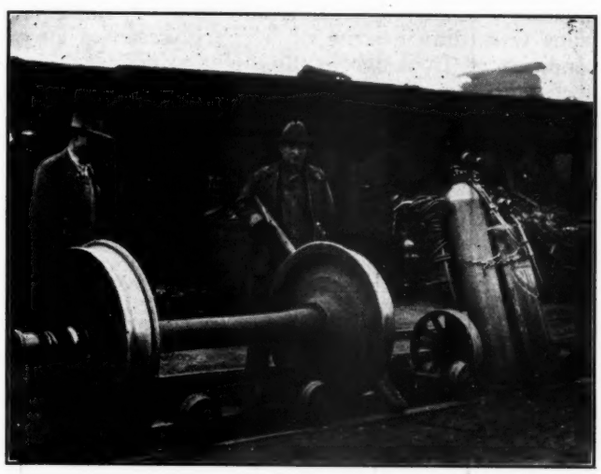
On the railroad where I am employed. we, as supervisors, endeavor to co-operate with the car department employees to the fullest extent, as well as all other departments and railroads. We have what is termed the "Car Department Co-operative Committee", which is composed of the different crafts in the car department organization—car repair men, steel car men, wheel shop men, acetylene torch men, air brake men and also the foremen, who meet once every thirty days at all of our large terminals or shop points, the general car foreman of each district being the chairman of the committee. At these meetings subjects of general interest and welfare of the employees and of the railroad company are brought to attention, suggestions are made by the men, and it is pleasing to note the good results that have been obtained through this medium. We should take the carman and inspector into consultation with us, let his troubles be our troubles, take personal interest in his work and give him credit where credit is due, working in harmony and co-operation. This is certain to bring us success.

By all railroad employees giving the proper co-operation, taking a personal interest in the operation of the railroads, and endeavoring to promote adequate, expeditious and dependable service, we should be able to look forward to the prospect of helping the railroads of this country increase their revenue, decrease their operating expense and put themselves on a paying basis equal to the other large industries. Giving the shipping public better and quicker train service will create savings for the manufacturers and distributors, result in smaller stocks of material being carried and provide quicker turn-overs and increased freedom of credit, which, as a whole, affects the entire business world and promotes general success and prosperity.

Small dolly cars save labor

CONSIDERABLE time is saved daily and the labor of moving wheels and other heavy equipment is lightened at the Denver shops of the Denver & Salt Lake, by the use of the small dolly cars shown in the illustration. A 20-in. gage track traverses the length of the rip track upon which the dolly cars run.

Two types of cars are used. The one for handling car wheels is made by mounting a 12-in. steel channel, 4 ft. 3 in. long, on two pairs of small loose wheels, by riveting it to the axles. A 5/8-in. by 10-in. plate, 5 ft. 5 in. long, is riveted inside the channel. This plate is



Two dolly cars used for hauling car wheels and acetylene welding trucks

bent down at each end of the channel to the level of the rails, and then bent back horizontally to hold the wheels in place. The ends of this plate are turned up 2 in. to keep the wheels from slipping off endwise. Small steel cleats are riveted to the plate so that the wheels will not roll off sideways.

The cars for moving acetylene tanks are made by riveting two 4-ft. sections of 5/8-in. by 4-in. straps to two axles. These sections are bent down between the axles slightly below the level of the track. Two short sections of 6-in. channel are welded crosswise on top of the 4-ft. sections at the proper distance apart to receive the wheels of the truck on which the acetylene tanks are mounted.

By the use of this equipment, one man can easily move a pair of wheels, or a heavy acetylene tank from one end of the yard to the other, where formerly two or more men were required.

BLANCHARD GRINDERS.—The No. 16 high power type of Blanchard grinder is illustrated in Catalogue No. 16 issued by the Blanchard Machine Company, 64 State street, Cambridge, Mass. Specifications cover both direct motor-driven and belted grinders.

The spot system of repairing freight cars

Baltimore & Ohio uses uniform procedure at all car shops—Adapted to four track layouts

BEGINNING about 1920, the Baltimore & Ohio started work on the introduction and development of a new system of repairing freight cars which, during the succeeding years, has worked with considerable success. Although the spot system was inaugurated in December, 1920, it was not placed in operation in all the car shops on the system until January 1, 1922. This system, generally known as the spot system, has been adopted, either in the complete form as used on the Baltimore & Ohio, or some modification thereof, by a large number of railroads.

Previous to the installation of the spot system, the management seriously considered the advisability of building a new freight car repair shop. A number of plans were drawn, some of which represented an expenditure of from two to three million dollars. However, with the spot system, the railroad has been able to abandon a number of its shops and, at the same time, maintain all of its freight cars satisfactorily in those remaining. Since 1920, the railroad has rebuilt over 90,000 cars, and built new bodies for over 8,000 cars, including all-steel hoppers of 50,000 lb. and 70,000 lb. capacity. In addition, it has built a considerable number of all-steel underframes for caboose cars.

The following description of the Baltimore & Ohio spot system is, to a large extent, the same as that prepared by the management of the car department for the information and guidance of its supervisory officers, and issued under the general heading, "Working system used in freight car classified repair shops and on shop tracks."

Unit organization used with the spot system

A unit organization provides for what is called a unit of force composed of a unit foreman, assistant unit foreman, and 48 workmen, who work on a designated track or tracks, in a shop or on shop yard repair tracks, where heavy repairs or rebuilding of equipment is performed. A unit of force works on all kinds of freight cars, except refrigerator cars, and is made up as shown in the table.

The unit of force for all except refrigerator cars

	Number
Unit foreman	1
Unit assistant foreman	1
Freight carmen	26
Air brake repairman	1
Blacksmith	½
Painter	½
Carmen helpers	11
Carman helper, (boxes, packing and oil)	1
Carman helper, (material man)	1
Painter helper	½
Blacksmith helper	½
Carmen apprentices	5
Shop laborer	1
Total	50

This unit of force is required to give heavy repairs or rebuilding repairs to a minimum of 15 cars per week and is required to repair and return to service each working day a minimum of 2½ cars.

The make-up of a unit of force for refrigerator cars is also shown in a table.

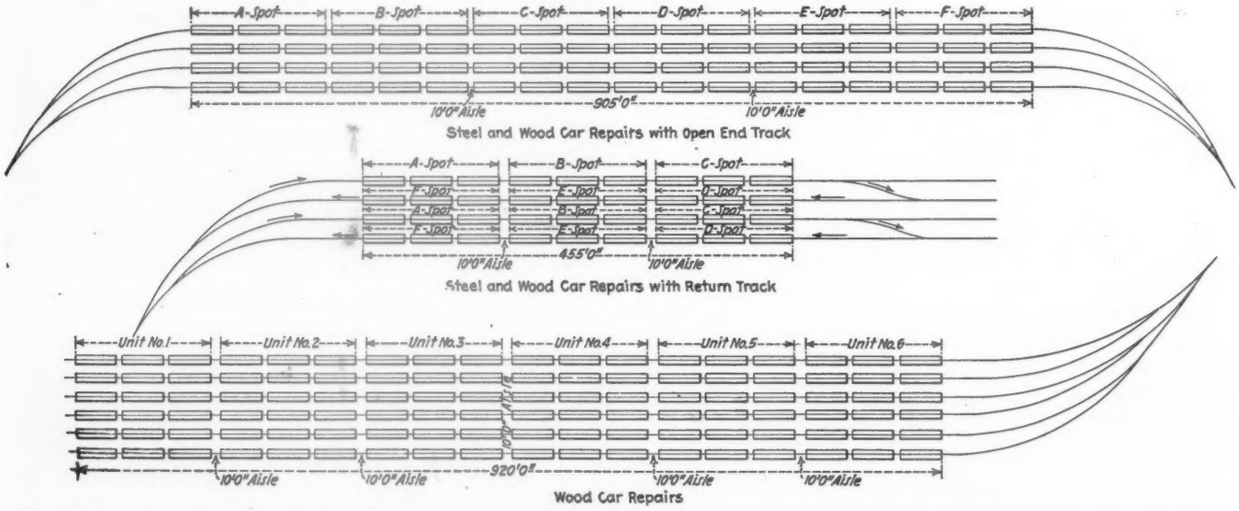


Fig. 1—Top, open-end layout for steel and wood car repairs; center, return-track layout for steel and wood car repairs; bottom, stub end shop layout for wood car repairs

Unit of force for handling refrigerator car repairs

	Number
Unit foreman	1
Unit assistant foreman	1
Freight Carmen	27
Air brake repairman	1
Blacksmith	½
Painter	½
Carmen helpers	12
Carmen helper, (boxes, packing and oil)	1
Carmen helper, (material man)	1
Painter helper	½
Blacksmith helper	½

Carmen apprentices	5
Shop laborer	1
Mill machine hand	1
Sheet metal workers and tinners	2
Total	55

This unit of force is required to give heavy repairs or rebuilding repairs to a minimum of six cars per week and are required to repair and return to service each working day a minimum of one car.

The spot system

The spot system indicates that certain repairs to a car are performed at designated spots on certain repair tracks in shops or in shop yards, where heavy or rebuilding repairs are made. The unit organization with

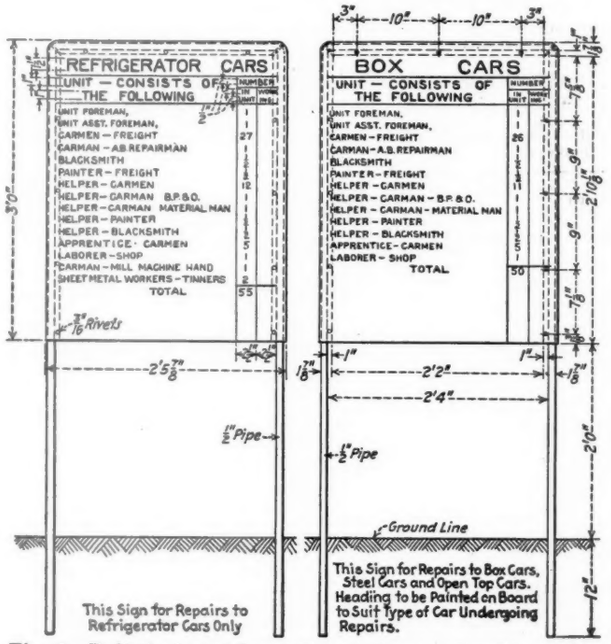

REFRIGERATOR CARS
UNIT — CONSISTS OF THE FOLLOWING
NUMBER IN UNIT
UNIT FOREMAN, 1
UNIT ASST. FOREMAN, 1
CARMEN — FREIGHT 27
CARMAN — A.B. REPAIRMAN 1
BLACKSMITH 1
PAINTER — FREIGHT 1
HELPER — CARMEN 12
HELPER — CARMAN B.P.&O. 1
HELPER — CARMAN MATERIAL MAN 1
HELPER — PAINTER 1
HELPER — BLACKSMITH 1
APPRENTICE — CARMEN 5
LABORER — SHOP 1
CARMAN — MILL MACHINE HAND 1
SHEET METAL WORKERS — TINNERS 2
TOTAL 55
BOX CARS
UNIT — CONSISTS OF THE FOLLOWING
NUMBER IN UNIT
UNIT FOREMAN, 1
UNIT ASST. FOREMAN, 1
CARMEN — FREIGHT 26
CARMAN — A.B. REPAIRMAN 1
BLACKSMITH 1
PAINTER — FREIGHT 1
HELPER — CARMEN 11
HELPER — CARMAN — B.P.&O. 1
HELPER — CARMAN — MATERIAL MAN 1
HELPER — PAINTER 1
HELPER — BLACKSMITH 1
APPRENTICE — CARMEN 5
LABORER — SHOP 1
TOTAL 50
3" 10" 10" 3"
3'0"
7/16" Rivets
2'5 7/8"
1/2" Pipe
1/2" Pipe
2'2"
2'4"
Ground Line
This Sign for Repairs to Refrigerator Cars Only
This Sign for Repairs to Box Cars, Steel Cars and Open Top Cars. Heading to be Painted on Board to Suit Type of Car Undergoing Repairs.

Fig. 2—Bulletin board located at each spot showing number of men assigned and number reporting

the spot system is worked in four different ways, which are as follows:

First—Repairing steel and wood cars on a layout with open-end tracks, Fig. 1. The repair tracks or shop tracks are of sufficient length to have 18 cars placed on each track, and each track has switch connections on both ends so that cars can be started in on one end at the stripping spot and then moved from spot to spot at the close of each day over the track to its other end. When it leaves the last spot it should be completed ready for service. The force on such a track should be divided into six gangs working on six different spots. Each spot should be of sufficient length to hold three cars, so that cars can be moved up one spot at the close of each working day until completed. This procedure insures completion of repairs to a car within six days from the time it enters the first spot to be stripped until it is repaired and returned to service.

Second—When the repair tracks or shop tracks are not of sufficient length to hold 18 cars, then that number of cars can be spotted on two adjacent tracks sufficient in length to have three spots on each track sufficient in length to hold three cars in each spot, or a total of 18 cars on two adjacent tracks. Referring to the diagram for steel and wood car repairs on layouts with return tracks, Fig. 1, cars placed for repairs on these tracks will first be placed on the stripping spot, which is located on the entering end of the track, and the cars will be moved at the close of each day from spot to spot over one track and thence via the cross-over to return on the adjacent track. On such tracks, one unit of force will be worked on two tracks in place of on one track, as in the first method.

Third—When the repair tracks or shop tracks have a stub end on one end, and switches connecting up the tracks on the opposite end, there should be a minimum of six tracks in the shop or shop yards. These tracks should hold a minimum of three cars each and facilities provided for one unit of force to be worked on the spot system across the shop or shop yards.

If each one of the six tracks will hold six cars it will provide two spots on each track with three cars in each spot, and two units of force can be worked across the shop.

If each one of the six tracks will hold nine cars on

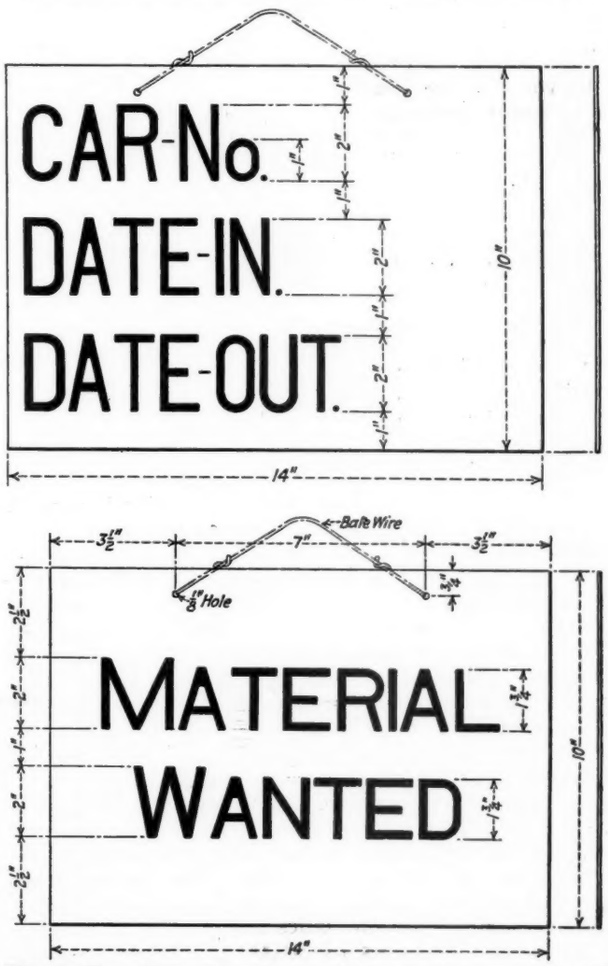


Fig. 3—Top, front side of car bulletin; bottom, reverse side

each track, it will provide three spots with three cars in each spot, and three units of force can be worked across the shop, etc. Such a shop will be worked in accordance with the diagram in Fig. 1, showing the layout of a stub-end shop for wood car repairs.

Each unit of force worked is assigned to a certain track or tracks in a shop or shop yard, and worked in accordance with the three diagrams shown in Fig. 1.

At the first spot of each unit of force is placed a bulletin board as shown in Fig. 2, bearing the names of the unit foreman in charge and the assistant unit foreman. It will also show the kind of workman assigned

to the unit foreman, who reports to the shop foreman.

Two columns are provided on this bulletin board. The left hand column shows the number of each kind of workmen composing the unit. The column at the right shows the number of such workmen reporting for work and is filled in with chalk immediately after the time of starting work each day, by the unit foreman in charge.

Near the corner on the side of each car is a bulletin, placed as shown in Fig. 3. This bulletin board is painted black on one side and bright red on the opposite side. The black side shows the date the car was placed on the first spot for repairs, and the date that the car will be completely repaired and returned to service. The red side shows the words in white letters, "material wanted." This side of the bulletin is placed out when material cannot be obtained, and also to show that the car is passing through the shop in need of material for repairs that could not be obtained.

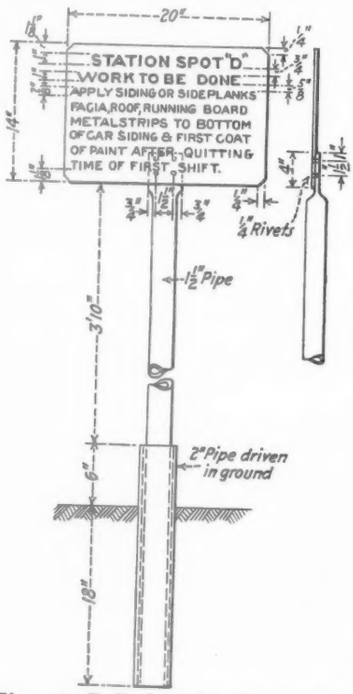


Fig. 4—Bulletin showing work done on each spot

Cars of the same kind and class, when possible, are worked through the spots of each unit to insure maximum output by co-ordinating the work and material as far as possible on cars being repaired by each unit of force. Repairing cars in this manner insures more satisfactory output and better work, than if cars of a mixed class and kind are allowed to pass through the spots of each unit together.

At shops where more than one kind of cars are being repaired, the units repairing each kind of car are segregated as much as possible. For example, if a shop is repairing both house cars and open top cars, open top cars should be worked on one side of the shop, and house cars on the opposite side. This proves more satisfactory than to mix cars indiscriminately, as it better separates the men and material.

At the beginning of each spot is placed a bulletin board for designating the work to be done at the spot, and this is painted the color by which the spot will be known, as shown in Fig. 4. The table shows the color of bulletin board, with the lettering used at each spot.

The color designation of the six spots

Spot	Color of Bulletin board	Color of lettering
A	Red	White
B	White	Black
C	Blue	White
D	Green	White
E	Yellow	White
F	Black	White

Work at Spot A (Designated with red bulletin)—Strip the car for repairs by removing all defective parts that are to be renewed or repaired.

Work at Spot B (Designated with white bulletin)—Repair the trucks, underframes, draft gear and attachments.

Work at Spot C (Designated with blue bulletin)—Steel cars: Fit and lace up all parts in place for the riveters, including floors, cross ridge sheets, side hoppers, longitudinal hoods, doors, etc. House cars: Repair and fit in place all framing above the underframe, preparatory to the application of the siding and the inside lining, floor and bevel strips.

Work at Spot D (Designated with green bulletin)—All-steel cars: Rivet up the parts of the car above the underframe and apply one coat of paint after quitting time for the first shift. Wood cars: Apply the siding or side planks, fascia, roof, running board, metal strips to the bottom of the car siding and apply the first coat of paint after the quitting time of the first shift.*

Work at Spot E (Designated with yellow bulletin)—Apply all safety appliances, hang and adjust the doors, repair the air brake and hand brake equipment and apply the second coat of paint after quitting of the first shift.

THE BALTIMORE & OHIO RAILROAD COMPANY
Motive Power Department

DAILY REPORT ON SEGREGATED FORCES AUTHORIZED TO BE ASSIGNED EXCLUSIVELY TO SPOT SYSTEM FREIGHT CARS REPAIRED. Date_____192__.

UNIT NO._____ KIND OF CAR_____ STATION_____

CONSIST OF UNIT					MEN OF AUTHORIZED UNIT ACTUALLY WORKING ON CLASS OF CAR FOR WHICH AUTHORIZED			NO. MEN OF AUTHORIZED UNITS WORKING ON OTHER THAN WORK FOR WHICH AUTHORIZED
OCCUPATION	NUMBER OF MEN				NO. OF MEN			
	ACTUALLY WORKING	ABSENT	POSITIONS VACANT	TOTAL	No.	TOTAL ONE MAN HOURS WORKED	REDUCED TO BASIS OF 8 HRS. PER MAN.	
Unit Foreman								
Unit Foreman Asst.								
Helper-Matl.Man								
Laborer								
Blacksmith								
Helper - B.S.								
Box Packer & O.								
Painter								
Helper Painter								
Air Brake Repr.								
Carmen								
Helper Carmen								
Appr. Carmen								
Tinner								
Helper Tinner								
TOTALS								

State here kind of work for men working on other than authorized work together with authority for same_____

State here individual number and kind of cars repaired and turned out of shop Today:

KIND OF CAR NUMBER

Cars reported repaired should include only cars passing over the spot system.

CORRECT:

UNIT FOREMAN.

Fig. 5—Daily report filled out by unit foreman for the car foreman

Work at Spot F (Designated with black bulletin)—Make the final inspection of the cars, test and adjust the brakes and stencil and ship the cars.

During the period that the unit organization and spot system of freight car repairs has been in effect, it has been found to work effectively with the Baltimore & Ohio's plan of employee co-operation. Among the advantages claimed are the following: Happiness and satisfaction among the workmen with maximum production from each man each day, and a minimum loss of material due to damage and waste.

* Metal strips applied at the bottom of the siding and metal roofs shown as applied at Spot D, may be applied at Spot E.

It further provides supervision that is both pleasing to the workmen and productive to the employer, because when advice is needed by the men, it can be promptly

THE BALTIMORE & OHIO RAILROAD COMPANY
Motive Power Department

DAILY REPORT ON SEGREGATED FORCES AUTHORIZED TO BE ASSIGNED EXCLUSIVELY TO SPOT SYSTEM FREIGHT CARS REPAIRED

STATION_____ DATE_____192__

CLASS OF CARS	AUTHORIZED NUMBER OF MEN: NUMBER OF UNITS	ACTUALLY WORKING TODAY	ABSENT TODAY	POSITIONS VACANT TODAY	TOTAL	MEN OF AUTHORIZED UNITS ACTUALLY WORKING ON CLASS OF CAR FOR WHICH AUTHORIZED: NO.	TOTAL ONE MAN HOURS WORKED	NO. OF MEN REDUCED TO BASIS OF 8 HRS. PER MAN	NO. MEN OF AUTHORIZED UNITS WORKING ON OTHER THAN WORK FOR WHICH AUTHORIZED	NUMBER OF CARS REPAIRED AND TURNED OUT OF SHOP TODAY
Box										
Open Top										
Refrig.										
W-1 Coke										
Mill Cond.										
Caboose										

State here kind of work for men working on other than authorized work together with authority for same.

State here individual numbers of cars repaired and turned out of shop today:

BOX	OPEN TOP	REFRIGERATOR	W-1 COKE	MILL COND.	CABOOSE

Cars reported repaired should include only cars passing over the spot system.

CORRECT:_____
CAR FOREMAN

Fig. 6—Daily report to the superintendent of the car department

obtained, which makes the conditions under which the employee is working satisfactory.

It provides maximum safety for the workmen, because all of their work is performed at a designated spot where the required facilities and material are placed. It is unnecessary for any one to collect his own material and tools from scattered points in the plant, which may subject him to all the hazards that may exist on the property.

It provides for maximum conservation of material because all material used in the work performed at each spot is removed from the car and re-used at the spot where it is removed. When new material is needed it is placed at the spot by designated material men.

It provides a maximum production from each workman for the reason that he is stationed at a specified spot where all the material and facilities needed are furnished for him to use.

The unit organization and spot system encourages the employer to provide steady employment for the reason

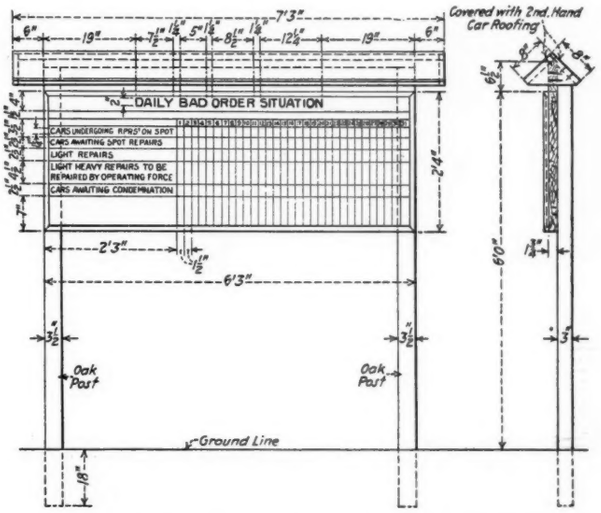


Fig. 7—Bulletin showing daily report of bad order cars

that it makes production cheaper than can be obtained through any other means, and provides for the satisfaction of his employees, because they are better able to produce satisfactorily.

Daily reports are made by each unit foreman to the car foreman in charge of the shop, on the form shown in Fig. 5. Daily reports are also made by the car foremen to the superintendent of the car department on the form shown in Fig. 6.

One or more weeks are allowed for one designated series or class of car to accumulate. During that time, the shop is kept busy repairing another series of cars. The foreman in charge of the shop is notified of the next series to go through the shop and the material is ordered and assembled at the proper spot ready for application. Thus, there is no delay in routing cars through a shop at any time.

Application for a patent on the system described in the preceding paragraphs was made by J. J. Tatum, general superintendent of the car department, Baltimore & Ohio, and filed December 31, 1923. The patent was granted November 10. 1925.

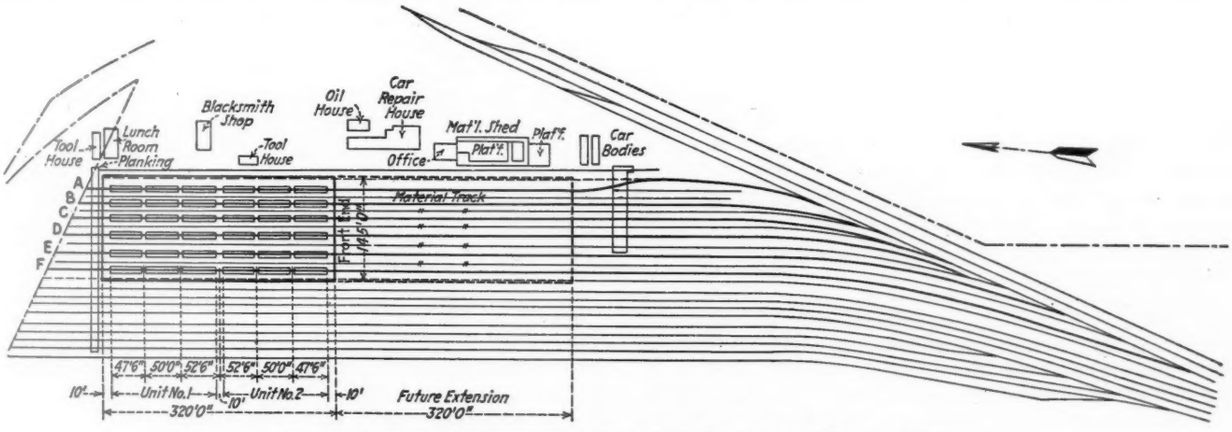
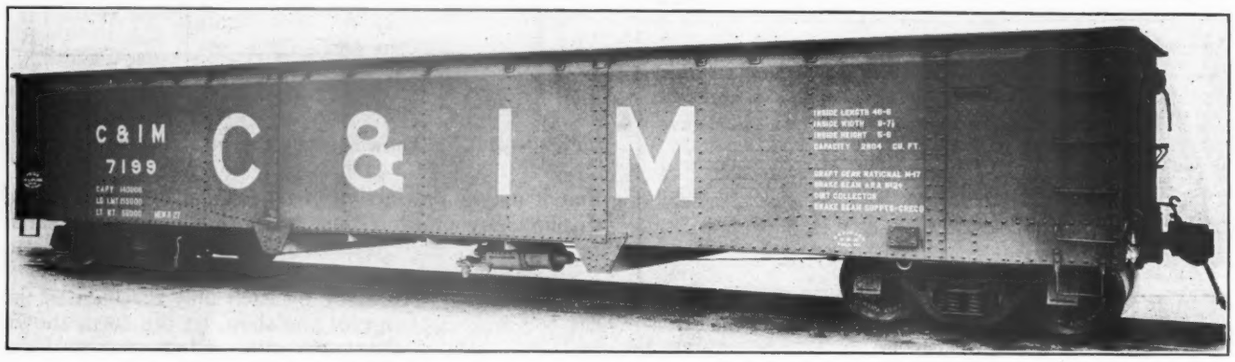


Fig. 8—Layout of car repair shop and tracks for repairing wood cars

Chicago & Illinois Midland gondola

New car designed for use in Chicago coal trade embodies novel features

THREE hundred and fifty all-steel gondolas of 70 tons capacity each were built recently by the Pullman Car & Manufacturing Corporation for the Chicago & Illinois Midland, having a number of new features of unusual interest incorporated in the design. Purchased to assist in handling the increasing coal business of the Chicago & Illinois Midland in Chicago territory, the cars are designed with sufficient clearances so that they can be unloaded in car dumping machines, being adaptable, therefore, to unloading by hand, clam shell, or car dumper. Owing to the use of floors sloping toward the center of the car and the fact that the body is low hung, the car has a low center of gravity conducive to easy riding and yet not low enough to induce undue rail or flange stress. While suitable for any other lading commonly handled in open top cars, these gondolas are expected to remain in the coal service, returning to the coal fields promptly after being unloaded and thus assuring a good average daily mileage for the cars.



New high capacity gondola for the Chicago & Illinois Midland

The cars are designed for long life and easy repairs. All steel, except the forgings, is of copper content to provide resistance to corrosion, the price differential of the higher grade steel not exceeding the cost of keeping cars out of service for one 30-day period on a per diem basis. The center sills and both ends are fully protected by the floor sheets, with the central portion only partly exposed to the elements or lading. The floor and side sheets can be removed without disturbing the center sill cover plate or main side stakes. Intermediate side stakes are riveted to the side sheets on the ground and applied with the sheets to the car. To as large an extent as possible, all parts are made accessible for easy inspection.

Another feature of the new C. & I. M. gondola is the fact that large capacity is secured without excessive height due to placing the side stakes on the inside and thus making possible the location of the side sheets about 8 in. further apart than usual. The tops of the side sheets are offset and flanged and double-riveted to give strength and increased capacity. Offsets at the car ends are provided for the application of ladder and grab irons without exceeding the permissible clearance limits.

Particular attention was paid to painting, the cars being thoroughly cleaned by sand blasting and immediately primed with one coat of Continental car cement. An additional heavier coat was applied later, the underframes also receiving this treatment. A coat of shellac is applied under the stenciling to keep the letters from turning yellow. The car is painted on the outside only, but will be painted inside after six months' service to fill the corners and protect connections and braces.

General description

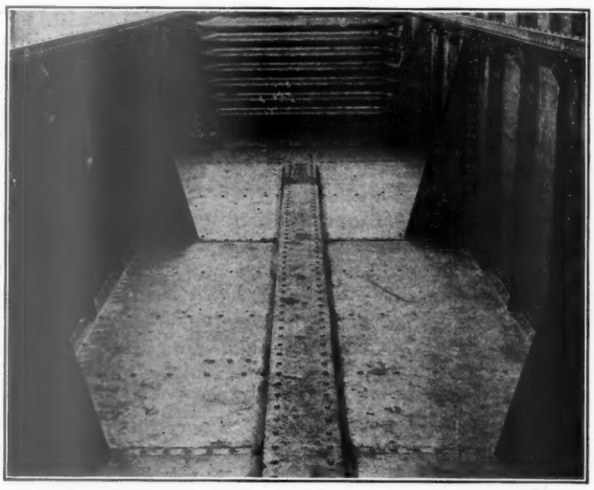
The new gondola is of the tight bottom type. The underframe is built up of channel center sills, angle side sills, angle end sills, angle diagonal braces, pressed pan bolsters, with top and bottom cover plates, two channel crossbearers, four pressed cross ties and three bulb angle cross ties and floor supports. The floor is made of 5/16-in. plates arranged to form a well extending from side to center sill and between the cross ties next to the bolster. The side frame consists of ¼-in. side sheets pressed inward at the top to connect with the bulb angle side top chord. There are seven bulb angle inside side stakes, and four pressed inside gusset stakes with angle connections on each side of the car. Ends are Murphy corrugated with bulb angle top chords. The trucks are cast steel of the Dalman type with integral journal boxes and cast steel bolsters. The general dimensions of the car are as follows:

Length inside	46 ft. 6 in.
Length over strikers	48 ft. ½ in.
Width inside	10 ft. 2½ in.
Width over side top chords	10 ft. 3½ in.
Height inside	5 ft. 6 in.
Height rail to top of side top chord	8 ft. 11 5/16 in.
Height rail to top of floor	3 ft. 5 5/16 in.
Height rail to body center plate	2 ft. 1⅝ in.
Truck centers	38 ft. ½ in.
Truck wheelbase	5 ft. 8 in.
Truck bearing centers	4 ft. 2 in.

In order to secure test data under actual service conditions, a number of specialties are being tested on these cars.

For example, while Klassing hand brakes are being used on 335 cars, 3 groups of 5 cars each are equipped with the following brakes: Konker with universal ratchet, Jemco with universal ratchet, and Universal booster and ratchet. National M-17 draft gears

are furnished on 315 cars, 5 cars each being equipped with the following gears: Cardwell G-125-AA special, Westinghouse N-11-A, Bradford R-1-A, Miner A-79



View showing the interior construction of C. & I. M. gondola

X, Murray H-28, Waugh-Gould No. 400, and Sessions Type L. The cars are equipped with chilled tread 850-lb. car wheels; Barber lateral motion device, using drop forged spring caps and rollers; also Barber single roller side bearings. The brake pipe, located between the center sills, is secured at crossovers with train line anchors furnished by the Illinois Railway Equipment Company.

The car, which conforms in all respects with the A. R. A. requirements, was designed jointly by E. O. Thedens, master car builder of the C. & I. M., and the engineering staff of the Pullman Car & Manufacturing Corp.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Depreciation computed from original date car was built

Detroit & Mackinac box car No. 373 was destroyed on the Pennsylvania System, September 12, 1925. This was a wooden box car equipped with cast steel draft arms, a friction draft gear and 5-in. by 7-in. shank, A.R.A. Type D couplers. The car was stencilled "Built March, 1924." This car was similar to two series of cars owned by the D. & M., some of which were built in 1896. The D. & M. reported that the original car bearing the number of 373, had been withdrawn from service with several other cars on April 18, 1923, and had been written off the records. A new car was built and put in service on March 17, 1924, and given the number 373 to fill the vacancy. The Pennsylvania contended that inspection of the car indicated that it had been in service at least 20 years and the fact that the car was stencilled built new, March, 1924, was in error. The car was only rebuilt in March, 1924, and, therefore, for settlement purposes, depreciation should be figured from the date of building the original car.

The Arbitration Committee stated that "Investigation by a representative of the Arbitration Committee failed to substantiate the statement of the Detroit & Mackinac that the body of this car was built new on March, 1924, within the requiremens of Rule 112 and Interpretation No. 3 thereto. The contention of the Pennsylvania System is sustained."—*Case No. 1550, Detroit & Mackinac vs. Pennsylvania System.*

Date of defect card governs responsibility for betterment charge

On August 1, 1926, the Indiana Harbor Belt renewed four pair of wheels on North American Car Corporation's car No. 1944 on account of being slid flat. A "No bill" repair card was attached to the repairing line's bill for this work. A defect card to cover these slid-flat wheels was issued by the Chicago Car Interchange Bureau, dated July 27, 1926, against the Illinois Central. The repairing line billed for betterment charges on the wheels and axles against the delivering line in view of Supplement No. 1, issued July, 1926, effective August 1, 1926. The delivering line took exception requesting that the amount of betterment be canceled because of the date of the issuance of the defect card. The Indiana Harbor Belt allowed the amount of betterment to the delivering line and requested the North American Car Corporation to furnish counterbilling authority to adjust the undercharge involved. In requesting the undercharge, the Indiana Harbor Belt claimed that the date of the defect card governs the responsibility, and the date of repairs had no bearing on the responsibility at the time the defect card was issued. The repairing line also claimed that Rule 106 did not apply as this rule states that the prices for labor and material in effect at the time the repairs were completed, shall govern, regardless of the date of the defect card. Furthermore, Supplement No. 1, mentioned above, did not change either the prices of labor or material, but changed the responsibility of the betterment charge on wheels from the owner to the delivering line.

The Arbitration Committee stated in its decision that, "The repairs covered by the defect card are subject to the rules in effect at the date of such card, except in so far as the prices for labor and material are concerned, the prices being governed by the rules in effect at the date of repairs. Therefore, the owner is responsible for the betterment charge."—*Case No. 1553—Indiana Harbor Belt vs. North American Car Corporation.*

Responsibility for additional damage sustained in switching a bad order car to the repair track

Trinity & Brazos Valley box car No. 2125 with three long sills broken new, had the three remaining sills broken when, on July 24, 1925, another car was switched against it in the Chicago, Rock Island & Gulf yards. The owner declined responsibility for two reasons: First, the C., R. I. & G. failed to comply with Rule 44 which requires that the owner be furnished information as to how all the sills had been broken. Second, the car was subjected to the provisions of Rule 32 as it was not involved in a movement at the time of the damage and received an impact exceeding that of ordinary switching when the

other car was kicked against it. The handling line claimed that in compliance with Rule 44 of the 1925 Code, it did not report the original damage to the owner on account of only three sills being broken. Furthermore, the car was not derailed, cornered, or side-swiped, the damage occurring in ordinary switching and therefore was not subjected to any of the unfair usage conditions as listed in Rule 32. Necessary rider protection was furnished.

The Arbitration Committee in its decision held the owner responsible. It stated that, "In the course of switching the bad order car to the shop track for repairs on account of three broken longitudinal sills, failure of the three additional sills occurred. Under the rules in effect at the time the damage occurred, the car was not subjected to any unfair handling within the scope of Rule 32."—*Case No. 1554—Trinity and Brazos Valley vs. Chicago, Rock Island & Gulf.*

Determining whether wheels have been brake-burned or slid flat

Four pairs of rolled-steel wheels were exchanged under Southern Pacific car No. 61992 by the Detroit, Toledo & Ironton on July 14, 1926. The cause of removal was given as "Brake burnt—peeled." The transaction resulted in the loss of 3 5/16 in. of service metal, the owner being billed for the entire expense involved in the exchange of the wheels. The owner contended that the wheels were slid flat, which is a handling line defect. Furthermore, while the defect "brake burn" is defined in interchange Rule 71 and classed as the owner's responsibility, the owner contended that such a defect would apply only to cast-iron or cast-steel wheels and that wrought-steel wheels from their very nature and process of manufacture would not develop such a defect under any circumstances. It might be possible for one wheel, or even a pair to develop an unusual defect, but it is not probable that all the wheels under a car would develop the same defect at the same time.

The Arbitration Committee in its decision stated that, "It is quite possible for wrought-steel wheels to develop a brake-burn. There is not evidence that the wheels in question were slid flat. The bill of the Detroit, Toledo & Ironton is sustained."—*Case No. 1555—Southern Pacific vs. Detroit, Toledo & Ironton.*

The owner's signature is sufficient under certain conditions

On August 29, 1923, S. F. P. & P. car No. 569 (belonging to the Atchison, Topeka & Santa Fe) was repaired by the Terminal Railroad Association of St. Louis, two short wood draft timbers, one deadwood, one carrier iron and necessary bolts being applied at the A-end. The A. T. & S. F. made a joint evidence inspection on November 26, 1923, within the 90-day period, covering two wood draft timbers which should have been Miner draft lugs, one deadwood framed without a striking plate, which should have been framed for the striking plate and one plain carrier iron which should have had the ends turned up. The joint evidence was presented to the repairing line which issued a defect card covering the wrong deadwood and carrier iron, but declined to card for the draft timbers, claiming the material was standard to the car. Later, the repairing line contended that no protection whatever was in order and requested cancellation for the return of the defect card covering the deadwood and carrier iron. The repairing line claimed that the A. T. & S. F. joint evidence was not valid because it was signed by one A. T. & S. F. inspector where the signature of another line should be secured, which fact voids the claim for wrong repairs. The owner claimed that the signature of its own inspector was sufficient, as the car was in transit, and it was not desirable to cut it out at the point of inspection for correcting wrong repairs because the proper facilities for doing the work were not available at that point. Therefore, it was not practical to get a second signature and in view of Paragraph 2, Rule 12, 1923 Code, one signature was used.

The Arbitration Committee in its decision did not sustain the contention of the Terminal Railroad Association of St. Louis. The decision went on further to state that, "A defect card is due the Atchison, Topeka & Santa Fe for the two wood draft timbers in place of Miner draft lugs, labor only; and for one deadwood with the striking plate omitted and a wrong carrier iron, labor and material."—*Case No. 1556—Atchison, Topeka & Santa Fe vs. Terminal Railroad Association of St. Louis.*

A centering device for the wheel shop

THE illustration shows a centering device which greatly facilitates the work of reclaiming bent axles. It consists of a strong steel bench, 6 ft. long and 12 in. wide, with a number of ¾-in. holes along the middle. Steel V-blocks each 6 in. by 6 in. by 12 in. are bolted into the holes in the middle of the bench. One of these blocks is placed about 24 in. from the end for a standard axle. The other block is placed where any bend in the axle may exist. If no bend exists, it is placed as

A centering device used to locate the centers in bent car axles

near the middle of the axle as will allow pick-up tongs to be adjusted. Small rollers set in the slopes of the blocks facilitate the rotation of the axle, when resting in the V-blocks. At each end of the bench is a gage or stop made from a ¾-in. by 4-in. bar, with numerous holes along its 2-ft. length and turned up at the end. It forms an adjustable gage against which to turn the axle while centering. It can be set for any length axle by moving from hole to hole the bolt which holds it to the bench.

With this device, the journal need not be checked against the middle of the axle, but may be checked and

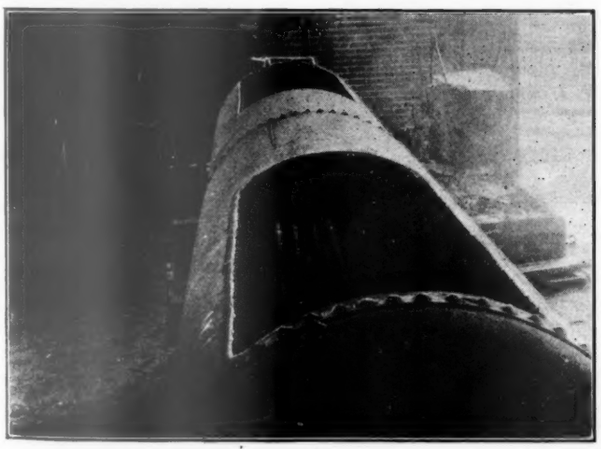
centered with any point in its length where there may be a slight bend, provided there is stock enough to allow for machining. After ascertaining this latter fact by measuring with calipers, the axle is placed on the blocks with one end against one of the stops. One of the V-blocks of the bench is placed beneath any bend in the axle, unless the bend is directly in the middle, in which case both blocks must be adjusted on each side of the bend, according to the judgment of the mechanic. Ordinarily the second block and the end stop is never moved, being located about 20 in. from the end of the axle, but can be placed at any point, without affecting the final result. The end of the axle is then chalked and the center located by placing a surface gage on the bench and drawing four lines across the end of the axle, turning the latter after each operation. The intersection of these lines will indicate the center of the journal in relation to the bend which is over the nearest block. The center is then marked with a center punch and drilled, using the stop on that end of the bench to brace the drill motor, as the other end of the journal rests against the gage at its end of the bench.

It is not necessary to turn the axle around when centering the second end. The centering tool may be placed on that end of the bench, but this would involve pushing the axle away from the end gage, so as to reach the center and to place the drill between the gage and the end of the axle. As the air tongs are handy, the operator finds it quicker to reverse the axle and the respective position of the vee-blocks. The axle is then ready for the lathe.

The axles are lifted into this device by a special pair of tongs, which are shown in the illustration, just above the gage. The boiler steel pads for the tongs are 8 in. square and curved to fit the axle. They are welded to the inner surface of the tongs which are attached to an air hoist hook.

Improvised tank for heating tar

WHEN it became necessary to rebuild a series of refrigerator cars at a large western car repair shop, there were no facilities at hand for heating the large quantities of tar used in laying the car floors. After several experiments, the heater, shown in the illustration, was rigged up from an old air tank, 16 ft.



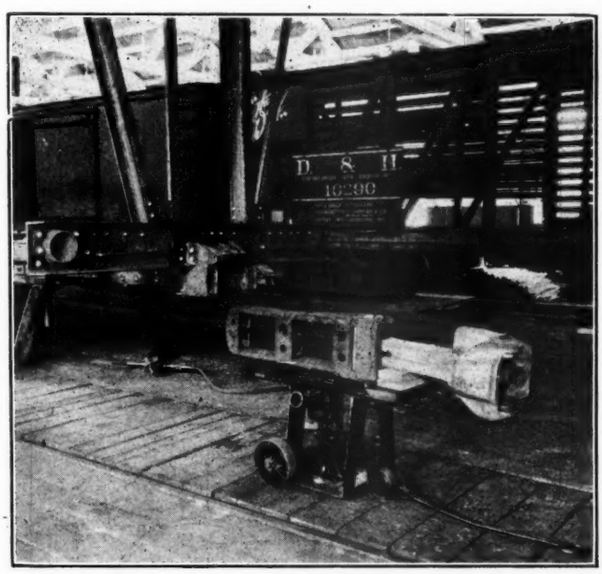
This tar heating tank was made from an old air reservoir

in length and 3 ft. in diameter. Two large sections were cut from the shell with an acetylene torch and covers made from sheet iron. Steam pipes were laid in the bottom of the tank and an oil forge built under it to heat up the tar, after which the steam served to keep it in solution. The barrels of cold tar are suspended over the openings in the tank by an overhead crane while the flame from a blow torch quickly loosens the contents and allows it to drop into the heating tank.

A large faucet is provided in the under side of the tank, through which to draw off the hot tar into large pots which are then carried to the cars by the crane.

Jack truck for applying draft gears

SHOWN in the illustration is a shop made truck for holding a jack for applying assembled draft gears and couplers. The truck is carried on three cast iron wheels and the base is raised from the floor by raising the handle. The base on which the jack rests is made



The assembled draft gear and coupler can be placed on this jack truck, moved under the car and quickly raised in position to be applied

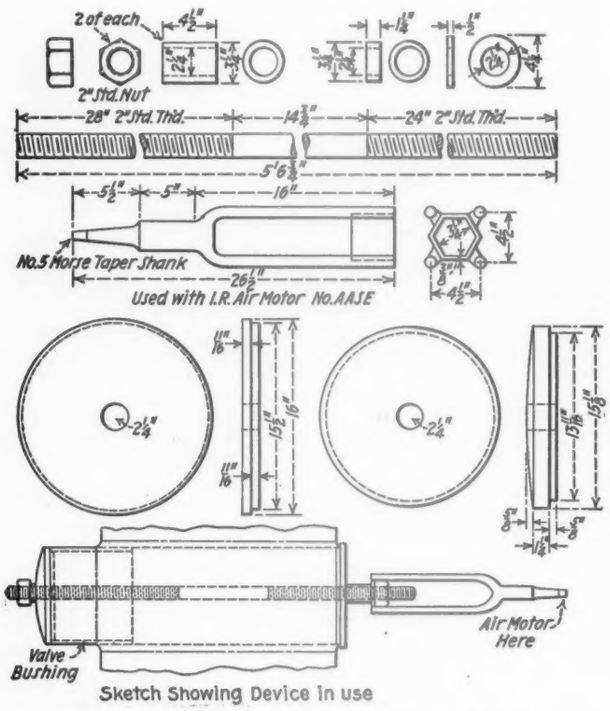
from a short piece of channel section. The remainder of the truck, legs and top, is cut from scrap steel plate. A jack of the customary design used in car shops is used. The only alteration made to the jack was to substitute a top piece flanged on both sides to hold the yoke in place, for the usual top piece furnished by the jack manufacturers.

TUBE COUPLINGS.—Several pieces of literature descriptive of Parker tube couplings and their aplication in buildings, power plants and similar structures, have been issued by the Parker Appliance Company, 10320 Berea Road, Cleveland, Ohio. These couplings are for use with copper or steel tube.

NEW DEPARTURE BALL BEARINGS.—Hitherto unpublished information concerning New Departure ball bearings is contained in the 40-page brochure just issued by the New Departure Mfg. Company, Bristol, Conn. The booklet includes revised tables of bearing types, first listing of new front wheel bearing sizes, correction factors for figuring capacities under combined radial and thrust loads, a table of decimal equivalents, etc.

Device for pulling in valve bushings

THE device shown in the drawing for pulling in valve bushings consists essentially of a long screw, two plates and a wrench of special design. It was developed by one of the employees of the Lehigh Valley shops, Sayre, Pa. To pull in a valve bushing, the bushing is placed in position ready to enter the chamber, the screw is passed through the bushing and chamber and



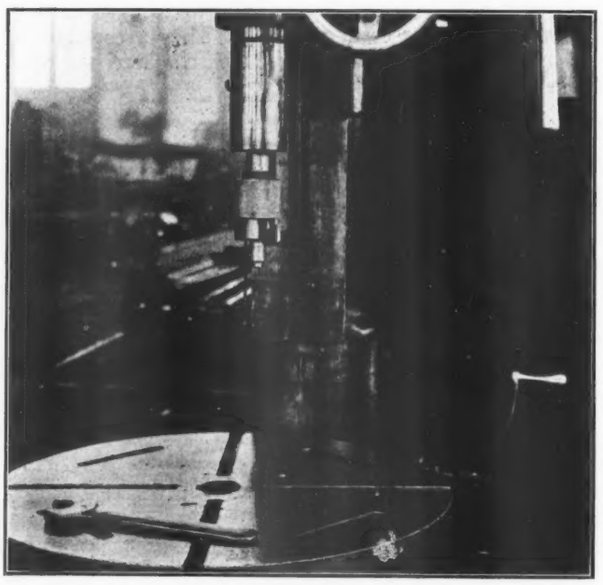
A device for pulling in valve bushings which is operated by an air motor

the plates are placed in position. One plate fits over the outer end of the bushing and the other plate, which fits the chamber end opposite the bushing, acts as a guide. The nut is placed on the screw. The wrench is then used to tighten up the nut by means of an air motor fitted to the tapered shank of the wrench, and the bushing is pulled into place.

Counterborer with a removable tool

THE conventional type of counterborer is made in one piece; that is, the boring tool cannot be removed for grinding. The disadvantage of the solid unit is that the boring tool cannot be ground square in the corners in relation to the pilot because of the round corner on the grinding wheel. It is important that the corners be square in order to obtain the proper finish in the piece being counterbored.

To eliminate this difficulty, a counterborer from which the boring tool can be removed, has been made in



A counterborer from which the cutting tool can be quickly removed for grinding

the Derby, Me., shops of the Bangor & Aroostook. The middle part of the boring bar is threaded, ten threads per inch, to receive the knurled collar which screws down on the boring tool and holds it securely in place. Different sizes of hardened pilots are held by a nut on the end of the boring bar. The taper of the boring bar shank is made to fit the spindle of various machines or air motors. The quick, easy removal of the boring tool is obvious.

Highball Scott, catalogue expert*

In which Bill Babbitt, whom you met last month, calls on the master mechanic and learns what a catalogue should not be

WHEN the water supply at Evergreen Farms failed to equal the increasing demands, William Edgar Babbitt, formerly Bill Babbitt, railroad supply man, set about to increase its capacity. A hillside spring and a narrow valley suggested a reservoir site. A small dam would do the trick. Now, if he had some good second hand steel—such as railroad rails; sure, why not see Highball Scott, master mechanic of the Carbon Valley Railroad? A day at a railroad shop would be an agreeable recreation to an old supply man. Also, enough could be saved by buying old rails for reinforcing material to insure Bill a good return for the

Bill Babbitt calls on Highball Scott

day's time. Thus, one fine July morning found Bill at the Carbon Valley shops.

Highball was whistling as Bill entered the office. Highball did not whistle before an audience and always appeared a little shamefaced when caught at his musical exercises. This morning all was well. Highball had completed his rounds and was ready to clean up on the morning's accumulation of mail. With the power in good shape and a smoothly working shop organization changing "dead ones" into "live ones" the old world looked rosy.

"Morning, Mr. Scott" said Bill.

"Morning sir. How are you anyway, Mr. Babbitt?"

"Bill, if you please".

"All right, Bill, I'm better known as 'Highball' so lets talk on that basis."

Bill's errand was soon explained. Highball was certain that the rails could be arranged for. Mr. Shafer, the purchasing agent would take care of that.

"You know, Bill I just got an idea. When you talked to me on the Ranger that night, I was inclined to be a little resentful. That darned Professor Jackson with his talk of "inertia complex" got me riled up. Of course, he doesn't know a hoot about the whole thing, nevertheless he gives a man a chance to see himself as others see him. And sometimes that same chance is worth a heap if a man is not near sighted. Now your little talk on how to treat a supply man has caused me to do a lot of thinking. That, together with some things I saw last night, convinced me that a lot of us grow shells and don't crawl out far enough to see the good in the other fellow. As a result we don't give him much consideration. He sizes us up from the same viewpoint and decides we are crabs. Get alongside the same fellow at a good dinner or at a little stag party, and you find him one of the type that would give you his shoes if you needed them. The idea I mentioned is that we fellows need to tell each other, as you told me, just in what we are lacking. In your own case, as a supply man, you would not tell a customer what you might like to but, as a a farmer you feel privileged to say what you think. Now, as two friends together, I am going to tell you some things I never told a supply man. Possibly if I had, conditions might improve.

"All supply men are not like you. I don't take you to have been one of the back-slapping or high-pressure types of pests. There are still a few in service. There is no reason why I should warm up to any of this type when they are almost total strangers to me. Possibly, if I were to tell a young fellow of that type that his sales efforts are all wrong, he might simmer down, act his age, and prove to be a mighty good up-and-coming young hustler. The thing I've got to get off my chest today is a grievance against catalogues."

What's wrong with the catalogues?

"What's wrong with the catalogues, Highball? I thought that supply people spent about all the time and money that could reasonably be asked in putting out catalogues. Our people used to put out a first class job, and, if I do say it, no concern ever used a better grade of stock in their catalogue or made an effort to get clearer illustrations than we did."

"Well, it isn't only stock or illustrations that count in a catalogue. That piece of work is, or should be, the company's resident sales agent. That representative should be a good fellow and answer my questions promptly and concisely. Bill, I find that, in too many cases, he does not do the job. I look around the office for some drill-press catalogues. Some have been sent me, but where are they?"

"In your files, of course," answered Bill. "Don't you keep a card index of catalogues so you can lay your hands on anyone you want?"

"Wish I could Bill. You see my mechanical magazines up on those shelves? Each one in proper place. Keep 'em for two, three years back, and half the time find them more dependable as a source of advertising information than the advertisers own catalogues. Can you, or any one else, line up Tom, Dick, and Harry catalogues in any such order? Here are some on this table. I refer to them quite frequently or they probably would have been in the waste basket long ago. Sizes, shapes, and colors as uniform as spots on a brindle dog. Now over here is our catalogue file. Look at this! And this! And this! These drawers are full of all sizes and shapes of catalogues. By the time a fellow finds what he is looking for the floor is covered with catalogues so deep

* The second of a series of stories written by a railroad man who was once a peddler.

it would take two office boys a week to clean up the mess."

The paper cutters' union

"Possibly you fellows have a gentlemen's agreement with the paper cutters' union. If so it will explain the freak sizes or outer boundaries of the catalogues. Here is one which, when stood on end, had a height of 11½ in. and a width of 4 in. Somewhat like the thin man in the side show. Here's another. Workwise he stands 4¼ in. high against 8½ in. wide. General outline resembles a starved dachshund searching for his master. Limp back too. All in all, just size up this bunch of odds and ends. The worst ones are piled on the window ledge there. Any length page from four up to twelve inches; any width from three to nine; any intermediate size that fractions and catalogue makers can combine. As for filing them! Sweet job. No sir! I find it easier just to pile the ones I need from time to time in some convenient place when I can pick them up as I want them. The remainder, we may say, are more or less of a loss.

"Why in the name of common sense do people that put out catalogues make these freak sizes? It would seem to me that it would be cheaper to select some regular size, something like 9 in. by 12 in, or whatever these mechanical magazine sizes are. Then a man could file them. It is a confounded shame that a manufacturer or dealer puts a lot of honest effort into preparing a catalogue and the net result is that the recipient heaves it into the waste basket. You don't use freak sizes of letterheads; mailing cards are all regular sizes, too.

"Why you people should set about to make something which will be distasteful to the man to whom it is sent, when it is your intention that he will keep it for reference purposes, is beyond my comprehension. Of course, Bill, I am only a railroad shop man, not a printer, nor an advertiser. On the other hand I am the man that the printers and advertisers are attempting to reach. Let me say to you that they are falling a long way short of their job. Suppose, now, that my clerk sent out some letters on 3-in. by 12-in. sheets, and some more on 10-in. by 4-in. sheets and used all the colors of the rainbow for writing paper. You would enjoy handling such correspondence, wouldn't you? Yes, you would not.

"So far I have only mentioned the outside of the catalogues and pamphlets that reach my desk. Once inside the covers, the real work begins. Let us, for example, look for a machinist's vise. Here is Coggs & Spindles general machinery catalogue. Inside the cover—what? Do we see a date? Sometimes, yes. In this case, no. Wouldn't it be well to put in something like 'Catalogue 43' or 'pamphlet D-6', or '1928 edition'; or some identification mark so that, when I write concerning some item mentioned in this particular book, I may refer definitely to the issue from which I secure my information? That would be a lot more agreeable to fellows like me than to have the manufacturer or the dealer write back and tell us that our reference to Fig. 329 Page 61 is wrong; that possibly we have an out-of-date catalogue and what we want 'will be found on page 27, part list MJ of our latest catalogue, copy of which will be mailed you under separate cover'. All of this polite explanation just when I want some particular 'gadget' from this concern, and want it darn quick.

"Then that family tree in the front section of the catalogue isn't exactly necessary. 'Coggs & Spindles Company—Established 1871', will show those interested that Coggs & Spindles is not a 'fly-by-night' concern. They put their birth date on their letterheads which is proper as I see it. If they believe the same information on the front page of the catalogue is likewise appropriate from the reader's viewpoint, it is sufficient.

"The location of the index in a catalogue is another important thing. It occurs to me that, a mighty good way to use up the first few pages, is to place the index in the front section."

"Well, to get back to drill presses," suggested Bill, who evidently was not entirely enjoying the lining out that Highball was handling the catalogue producers, "you said something about having an old drill press. Let's talk about it."

"Oh, the one I have is just plain drill press. It is still serviceable, though a little worn and does not have the latest improvements. You can see it outside that door."

"Yes, I see it", said Bill. "A little out of date.

Highball's catalogue file

Mmmmm, hand feed; spindle appears to be bent; some rack teeth missing; frame patched; three-step cones; no back gears; table somewhat damaged; otherwise, pretty fair machine. By the way, Highball, did it ever occur to you to try replacing worn and broken parts of machine tools?"

"Oh, yes, certainly. That is another job where the cross-word puzzle fiend gets in his fine work. I cheerfully admit that I don't expect a manufacturer to maintain drawings, jigs, fixtures, and patterns for equipment built from 30 to 50 years back, but your equipment need not be that old in order to give you all kinds of trouble in securing replacements.

"Only a short time ago it required something like sixty days time plus several letters, together with a goodly amount of effort on our part, to secure a rather simple casting for a piece of shop equipment built considerably less than 20 years ago. We find that we need this particular item. We examine the machine carefully and find no serial number. Nothing unusual about that, as this was not a machine tool, but just one of the small pieces of auxiliary shop equipment. We do the next best by stating the capacity of the appliance and copying all casting numbers and other marks of identification to be found on the piece which we require.

"In due time along comes a replacement which does

not fit at all. We write back to Mr. Shafer, our purchasing agent, and he in turn relays the information to the manufacturer that the piece we have received does not engage properly in the companion piece. Some genius in the manufacturer's organization overlooks the fact that we state in our letter that the piece which we have received does not bear the same numbers as the piece which we require. Instead he hastens to assure us that the companion piece is worn out and that if we order a replacement for the companion part, he is certain we will have no further trouble.

"We write back, again telling the manufacturer that we have not received the piece which we ordered. He sends us a part list from which we learn that the piece which we require, formerly 3-RJ-41, is now know as 4-K-237. We write again and inform him that the identification marks on the piece which we have on hand do not tally with the original, quoting in full the wording of our first letter, and in due course of time receive not the 4-K-237, but our old friend 3-RJ-41. A few experiences of this kind will teach a man to avoid the snares and pitfalls of the part catalogue by the alternative of making the required piece himself.

"Of course, as long as the machine will limp along, the current demands upon its production must be satisfied. Finally the broken rack or sprung spindle became an old story. Having been that way quite a long time, we finally decide they will last as long as the remainder of the machine. The part catalogues or repair lists certainly have caused shop men a needless amount of trouble."

The catalogue should answer questions

"I said a while ago that the catalogue or advertising pamphlet, if you please, should be a good fellow and answer my questions promptly and concisely. Did you ever consider, Bill, that even the arrangement of the pages of a catalogue might mean serious trouble to the user? Of course you didn't. Allow me to cite a case. We will call the tool in this case a 'high speed egg peeler' simply because it wasn't that, but it was a portable tool designed for use in a railroad shop. In addition to manufacturing tools for railroad shop use, our worthy friend builds some equipment for marine service; in addition to this he builds another line for stationary service. The general outline and shape of these tools is much alike in all cases, but on account of the different service required, parts of the machines for marine work, although the machine may be nominally the same size as for locomotive work, will not interchange with machines designed for locomotive work.

"Our shop foreman, who is usually a very careful man in ordering parts, runs through the catalogue until he comes to an illustration appearing on the right-hand page as you look at the catalogue, which shows a locomotive egg peeler. Facing this, but on the left hand page, is a nicely arranged repair part list. To complicate matters each machine has a pet name. The locomotive type machine is known as the 'Whirlwind'. The marine type is called the 'Windstorm' or some other equally meaningless designation. He knows that our machine is a 3½-in. size. On the opposite page he sees repair parts for all the different size machines and promptly selects a choice lot of 3½-in. replacements for the 'Whirlwind' machine. The parts are received in due time, but do not fit properly. The foreman, being of tolerant mind and realizing that all humans are subject to error, makes slight alterations in the parts received and applies them to the 'Whirlwind' machine. It is only after a storm is raised over the inferior work done by the 'Whirlwind' machine that we get down to an honest-to-goodness investigation. The business of digging up requisitions brings to light the fact that the foreman should have turned over a single page where he would have found replacements for the 'Whirlwind' machine, marked on the reverse side of the leaf showing the assembled machine. The parts he ordered were for the 'Windstorm', of course.

"If I were compiling a catalogue, I would place myself in the other fellow's shoes. I would keep in mind at all times that he was a busy man; that the catalogue was prepared to expedite the selection of new machines or replacements for existing machines, and not as a super-testing device to gage the cubic contents of a shop foreman's intelligence.

"Possibly, Bill, you think the foreman in question is below the average in intelligence. You have a right to your own opinion, but in order that you may not be misled, I want to assure you that that particular foreman has held down some mighty responsible positions. The fact of the matter is he is here chiefly because he likes to live in a small town and because the Carbon Valley shops appeal to him as a good place for a man to make a living."

Punishment for catalogue makers

"Did you ever know a man who wrote an illegible hand and then complained because others couldn't read his handwriting? You know the arrangement of the information that we secure in circulars is a good deal on that order. Sometimes I think it would be a fine pastime to put a few catalogue makers to digging information out of the other fellow's catalogue, while they answered telephones, told Jack what size tap to use on that special cab fountain; gave another fellow, offhand, the condemning limit for tires on a certain class of power, and during the intervals listened to the complaint of someone who was waiting for the other fellow to allow him to proceed with his work. If these boys would all give us their stuff right the first time I would be very much surprised.

"If I were building or selling supplies of any kind, and the supplies contained numerous parts, subject to renewal, I would first make an attempt to arrange my wares in the catalogue pages the same as I would if I were displaying them in a show window or on a counter in a store. Would you, for example, if you were selling clothes, hang the trousers in the window and leave the coat and vest in the stock room? A customer coming that way, would, of course, know that you had clothing to sell. He would also know that the goods were of a certain color, but he would not know from the looks of the trousers whether you are offering a two-piece or three-piece suit. The coat might be a two-button or three-button cut-away, or it might be a double-breasted effect. Now in the same manner I would consider an illustration for the egg peeler I mentioned. I would show an assembly of the egg peeler on a standard size sheet. If I made several styles of egg peelers, I would identify them by listing them as "A", "B", or "C", the same as the pneumatic tool people identify their portable tools. The simpler the classification, the better. If I built the tools for stationary, marine, and for locomotive service. I would say that type "S" stood for stationary service. As you pass through the catalogue to the locomotive type, you would find type "L" for use on locomotives, the initial "M" the designation for marine work, which would be less burdensome than such fantastic names as "Tiger", "Victor", "Dreadnaught" and other ill-fitting and meaningless appellations. If the device happened to be, for example, a tube expander, the symbol L-3½ would not

be burdensome to a man's mind in consulting the catalogue or part list—"L" for locomotive; 3½ for the diameter of the piece where the device is used.

"Wouldn't you think, Bill, that it would be well to put below the type "L" assembly, or if space would not permit, on the facing page to the right, the part list for the "L" type machines? What I am saying may sound odd to you, but it is a fact, nevertheless, that if I had two makes of egg peelers in use in this shop, other things being equal, when new machines were to be ordered they would come from the manufacturer who furnished replacements with the minimum amount of fuss and trouble.

"Here is another thing about catalogues and pamphlets which I dislike. Here is a certain appliance built in several types for varying service, and each type is identified by a name, such as "Panther" or "Wolf" or similar terms. Two or three pages are taken in each case describing the good qualities of each particular type of machine. Then a generous amount of space is consumed in giving views of a very ordinary machine shop or tool shop in which the parts are manufactured. Nothing particularly attractive about the shop views and they are absolutely without interest to the user of the machine. Further along we find pages showing the choices offered us in the different attachments to the several types of tools which we may elect to purchase. There is nothing connecting the description of the machine with the attachment information.

"Now, in contrast to all this, just look at this Blank & Blank catalogue. A good husky but unpretentious cover; stamped on the back where it is plainly visible if it is in the file, appears 'Blank & Blank—Milling Cutters—1928 Catalogue.' Opening the catalogue we readily find a table of contents. We may easily refer to this and find with minimum effort anything this company makes in the way of a milling cutter. Do they waste space in showing views of the mill where the tool steel is rolled or do they illustrate the latest model tempering furnace? No, sir. Milling cutters from the table of contents clear through to the last illustration. Following that is a clearly arranged series of drawings together with considerable printed matter giving instructions on how to mount milling cutters on the arbors; what feeds and speeds to use to secure the best results in milling operations and points on the general care and maintenance of milling machines.

"I want you to know, Bill, that to my mind, there's a catalogue that is a catalogue, and there isn't a square inch of space given over to anything that would appear superfluous to the shop man. The fellow who compiled that book saw the subject from the user's viewpoint and not from that of a body of experts who specialized in the manufacture of milling cutters.

"The information given in the pages following the cutter descriptions would not be of any importance to builders of milling machines. They know all that, but the average fellow in a repair shop appreciates that particular information and when a new catalogue from this concern reaches my desk, the old issue goes out to the shop. The boys prize them highly. Among that lot of books that you see on the shelf is an old catalogue that had a place of honor in my locker when I worked as a nut-splitter. A good-hearted foreman gave it to me one day and suggested that I might learn something from a study of the contents. He was right. I did."

"I am sorry, 'Highball', that Tom James hasn't been here this morning to hear your little sermon on advertising literature from the user's viewpoint. It has been mighty refreshing to me to absorb what you have related, and I believe that you are pretty nearly right. What you have said to me only verifies your statement that sometimes it is good for a man to be enabled to see himself as others see him, provided, of course, he is not too near sighted or too much of an egotist to be told something for his own benefit.

"There is one important point that you have not touched directly upon, but you have unconsciously brought it out in your statements. It is this. You referred to Blank & Blank cutters. I happen to know that company. They are a reputable concern. They have been in business for a long time, but they wouldn't try to get by on past performances. They are keeping step with the best manufacturers today. They have had years of experience in compiling catalogue information just the same as they have had in making milling cutters. I suppose you use their cutters, Highball?"

"Certainly we use their cutters."

"Any particular reason aside from their printed matter?" asked Bill.

"Yes, of course. I have never found cutters that were better than theirs, and possibly there are mighty few that are as good."

"How about price?"

"Well, the price is a different story. Mr. Shafer, our purchasing agent, has suggested to me from time to time that he could secure milling cutters at a more attractive figure than that submitted by Blank & Blank. I have tried the other cutters. Yes, more than once."

"How come then that you still use Blank & Blank cutters, when the price submitted by the other fellow was more attractive?"

"The prices were good—the cutters were not." said Highball. "You can't slab down side-rod forgings or mill driving-box shoes and wedges with a fairy story about low-priced cutters. You must pay the price if you want dependable tools. In other words, reminds me of what my old boss used to say, 'You get what you pay for; don't expect too much for nothing'."

"It is just too bad that Mr. Shafer isn't with us this morning," said Bill. "I could tell you the same story about machine tools and all other shop equipment that you have related concerning Blank & Blank milling cutters. You might, for example, make two castings, using in one 40 or 50 per cent zinc and the remainder composed of scrap copper, a trace of tin and some floor sweepings. You might use in the other something like 88 per cent copper and 12 per cent tin, or one might make a bell-metal alloy where your tin is nearly 25 per cent. All three castings might be the same size. Very little difference in weight, but what a whale of a difference if you put the 40 per cent zinc job in a place that requires the 88-12.

"However, if you feel for price and price alone, certainly you would buy a fine bunch of zinc rated under the name of brass. The fellow who makes the 88-12 mixture, like your Blank & Blank cutter concern, won't cut prices for the simple reason that he will not reduce the quality of his goods. Two makers might even buy their castings from the same concern. Yet, one is able to undersell the other on account of sharp practices in manufacturing operations.

"I am now only advertising 'Tree Nursery Products'. But I intend to keep what you have said in my mind at the time I issue my new catalogues. Possibly some of the old concerns, and certainly a lot of the later ones, would benefit materially by your sermon on the art of arranging advertising pamphlets. To be sure a good honest old trade name will pick up a lot of friends and overcome a multitude of sins. A reputation for integrity earned by years of honest and serious methods

should not be impaired by inferior advertising matter."

"Well, Highball, I've got to be running along. I'll go over and see Mr. Shafer about selling me those rails, although if he has as much trouble finding out from his records whether or not he has any as you seem to have had in finding information in a catalogue it'll probably be all summer before I get the dam built. In that case I'll come down often and battle with you on several other points that you probably have in mind. Sure enjoyed the argument—and I'll see you later."

Spring plant of the Baltimore & Ohio at Mt. Clare shops*

Design of plant and equipment with successful methods of manufacturing elliptic springs

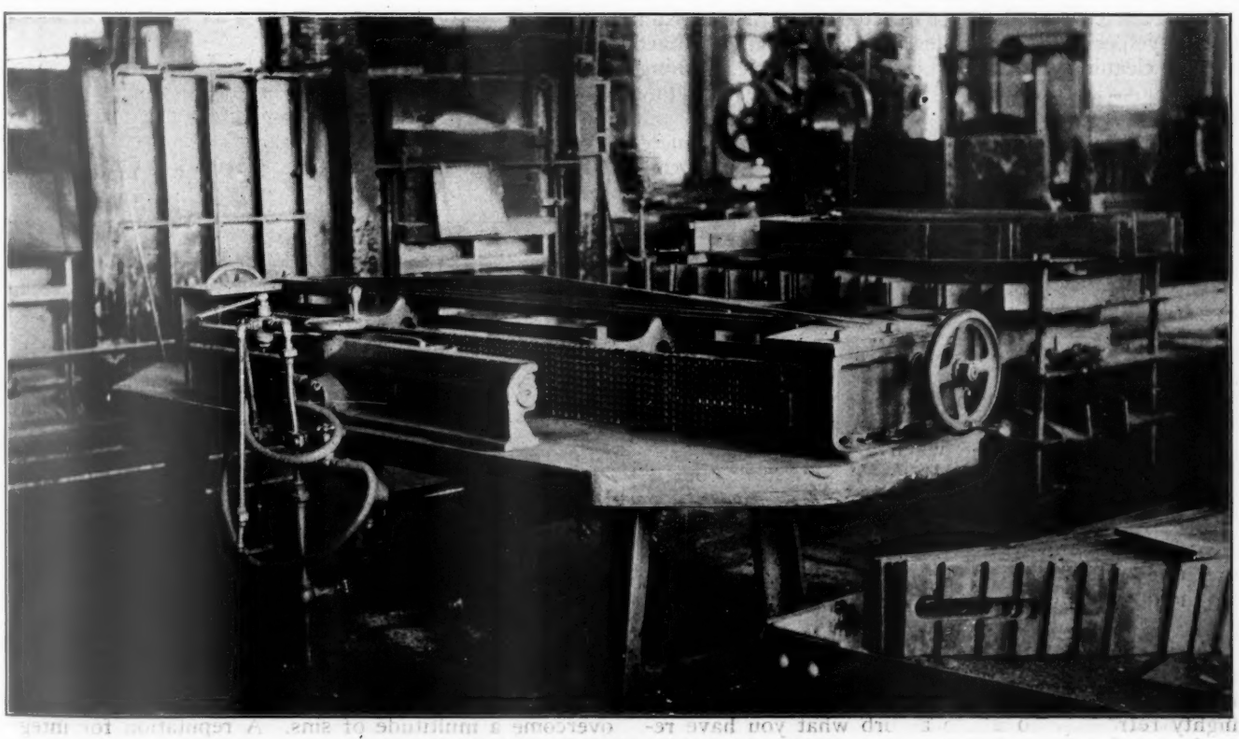
IN the beginning, a tabulation was made of the springs coming in for repairs to study the failures with a view to determining whether any particular design was contributing largely to the failures. The conclusion was that the design in the main was not the cause.

Being satisfied that it was not a question of design, we then investigated the manufacturing process. The system in use was to allow the leaf to cool after forming, then heat for quenching, quench in heavy oil, and heat for drawing the temper by a flushing-off oil.

Tow pieces of steel 2 in. by 12 in. by ¼ in. from stock bars were cut from each of six bars and reduced at the center to 1 in. width, thus giving an area of 1 in. by ¼ in. Six of these pieces were treated in accordance with the method then in use for manufacturing springs. A test of these pieces was then made to determine the tensile strength, elongation, reduction of area and Brinell hardness; the other six pieces were heated to 1,500 deg. F., quenched in Houghton's No. 2 soluble quenching oil, and four of these six pieces were then drawn in Houghton's Draw Temp to 820 deg. F. They showed practically the same Brinell hardness as the six pieces heat treated by the old method. These latter four pieces were pulled and showed a much higher tensile strength and a greater ductility—a fundamental necessity to get full value of the steel plates.

The next step was to fill the quenching system with new oil. The system consisted of a storage tank and four small quenching tanks holding 250 gallons each. There was also constructed a new Draw Temp heating furnace, underfired and using high pressure air and

* The report of a sub-committee of the Committee on Locomotive Design and Construction presented at the convention of the Mechanical Division, A. R. A. at Atlantic City, June 20-27, 1928. The sub-committee report was signed by G. H. Emerson, chief of motive power and equipment, B. & O.

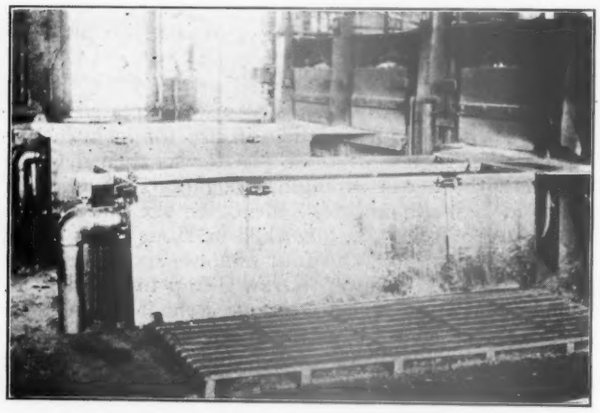


View of the spring plate forming machine

brick deflection, the old furnaces being continued for use in quenching and forming the springs.

Test pieces were taken, given the proper camber and then tested for deflection and set. By checking various temperatures it was found that 810 deg. F. draw back permitted the leaf to be deflected to an extent equivalent to a reverse camber without taking a set.

A further check being made of broken springs, it was found that the grain structure showed a considerable variation, thereby explaining one of the causes of a failure of the plates. From the two micro photographs, the difference in grain structure when steel is quenched at 1,500 deg. or 1,700 deg. may be noted, thus illustrating the importance of quenching quickly from the furnace. Brinell hardness tests on hardened plates indicated surface decarburation due to flame contact. Poor oil and air admixture resulted in excess scale, which

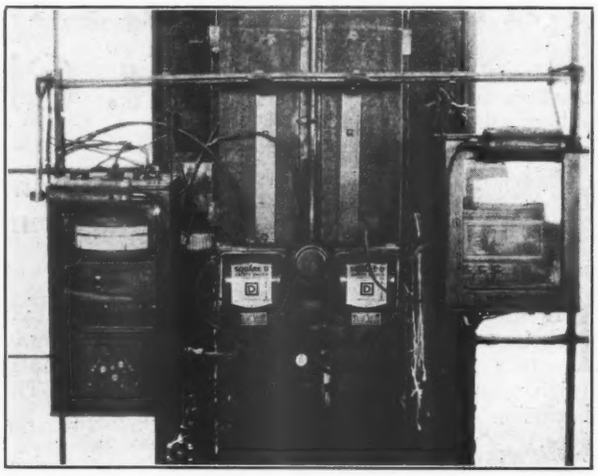


Oil quenching tanks are located close to the furnaces

scale accumulated in the Draw Temp pot preventing dissipation of the heat and burning through the bottom of the pot which was made of plate steel. A new Draw Temp furnace was then constructed using a cast iron pot. By special care in protecting against flame contact and by cleaning the pot regularly of the scale, burning of the pot was prevented. High pressure oil and low pressure air were used in operating this tank.

It had been the practice to heat treat replacement leaves only, which naturally resulted in the final spring assembly being made up of plates of varying physical strengths and consequently resulting in failure as soon as the weakest plate was strained.

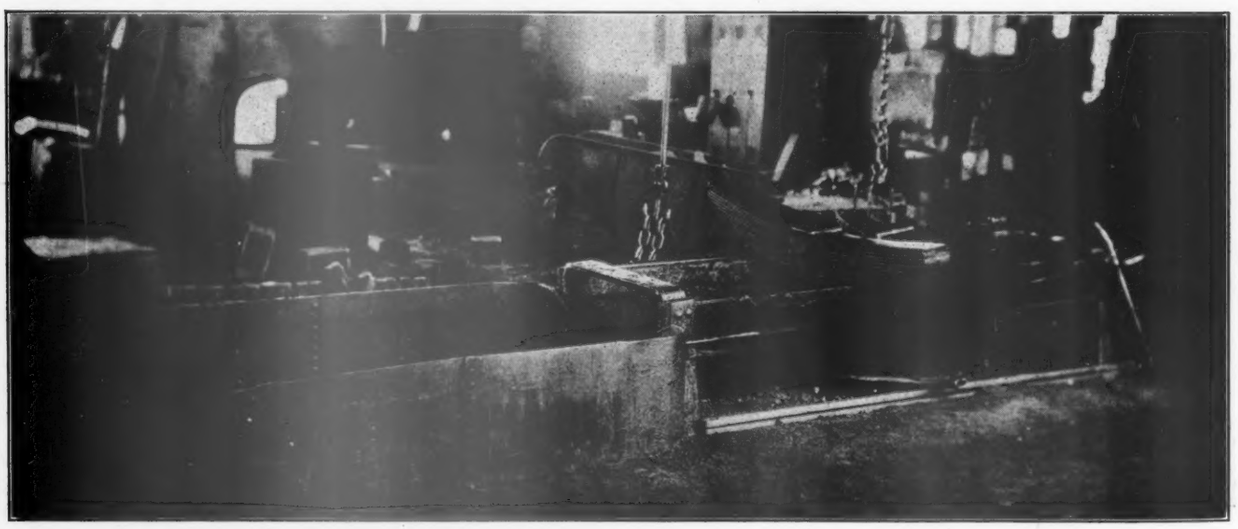
In order to treat all the plates in the springs as they came in for repairs, the plant was redesigned with a view to giving sufficient time for the plates in the furnace to be thoroughly and properly heated. The furnaces for heating, for forming and for quenching were



Pyrometer used with Brown automatic furnace control

constructed for firing under the arch and vents were provided through the sides from the hearth. This increased capacity made it necessary to increase the quenching system so that the oil could be kept at approximately 150 deg. F. in order to quickly quench the maximum tonnage per gallon of oil. Tests were then made of the springs in which every leaf was heat treated in the same manner; various temperatures being used for heating, for quenching as well as drawing temperatures.

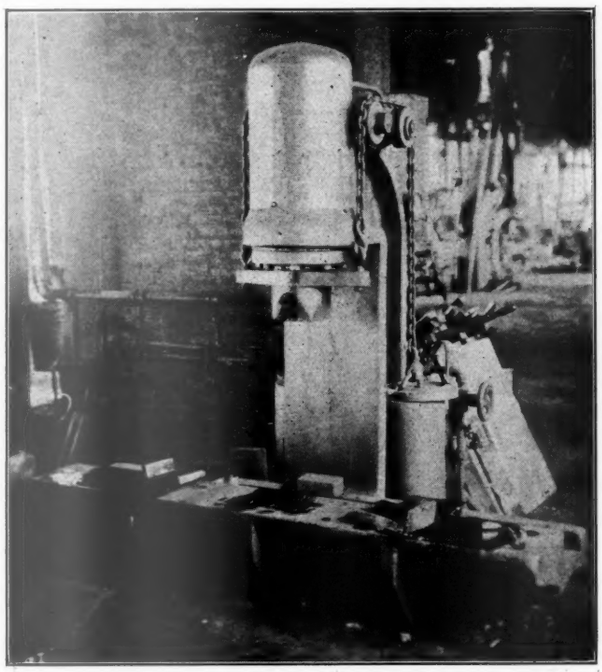
Springs with 15 plates, 36 in. by 5 in. by ½ in. were tested. The springs were heated in the quenching furnace in pairs with their corresponding test piece to the desired temperature, then quenched in a circulating bath of Houghton's No. 2 Soluble Quenching Oil. Brinell



After banding, springs are immersed in oil and drained to secure lubrication and prevent corrosion

readings were then taken from each of the hardened test specimens. After quenching, springs were drawn in a salt bath with a test specimen representing each heat. Specimens then banded, stamped, dipped in lubricating oil and pumped down once under the tester to take up any space between the leaves.

The springs were first checked to blue print specifications, after which the height of each was determined under a 50,000-lb. static load. Each spring was then compressed in a bulldozer 1,000 times with the stroke adjusted to produce a height equivalent to that obtained under the 50,000-lb. static load. This load applied at the rate of 500 loadings per hour by the bulldozer, was arbitrarily chosen and is double the normal working load of this type spring.



Machine used for testing springs

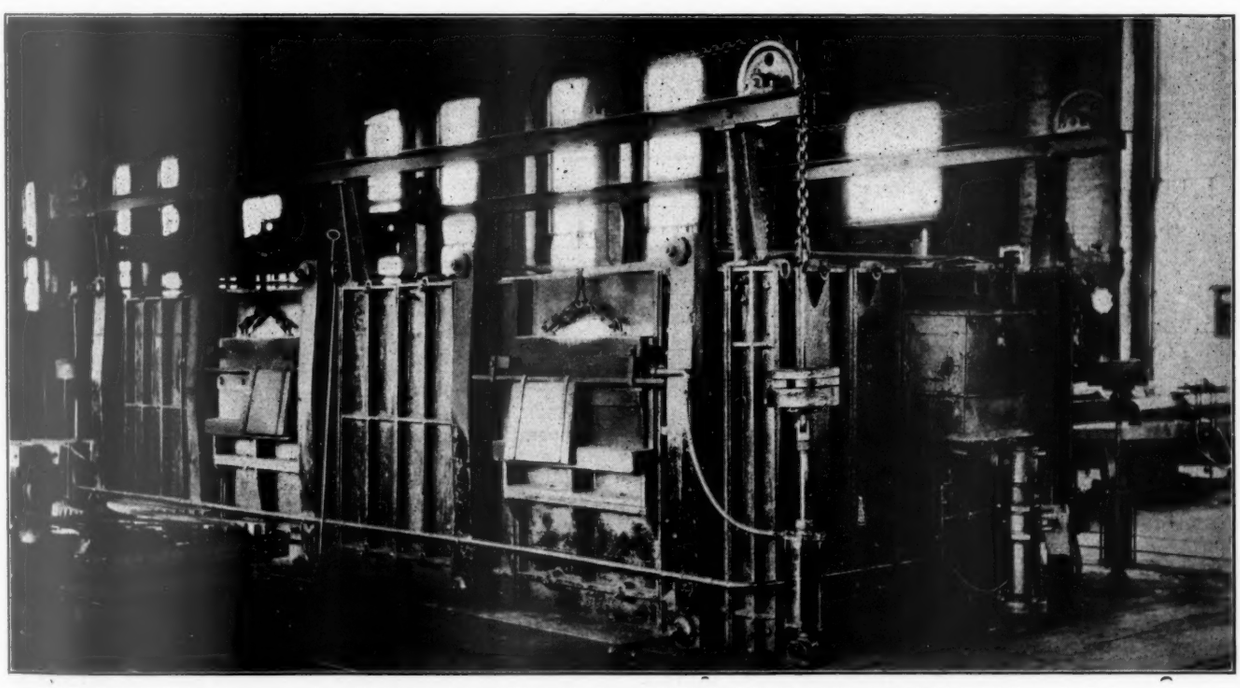
At the completion of 1,000 loadings on the bulldozer, the springs were again checked under the static machine and the new height under a 50,000 lb. load determined. All the springs were again returned to the bulldozer and 1,000 load applications made at this new height.

Upon the completion of this second series of 1,000 load applications, the static load was increased to 60,000 lb. and the corresponding height used for service test on the bulldozer. A record nevertheless was taken of the height of each spring under the 50,000-lb. load.

The furnace used for the salt bath

The failure of any plate, except the short plate, was recorded as a failure of the spring. The number of applications and locations of the break were noted.

The test was continued in this manner until 10,000 applications were reached when the tests were discon-



Forming furnace of Baltimore & Ohio spring plant at Mt. Clare shops

tinued and the spring standing this test selected. The same jigs, clips and pins were used throughout the test. All errors due to wear were thus cumulative and applicable to each spring.

A load of 40,000 lb. was applied to each spring and released each time before running them down on the static machine.

Automatic regulation was installed in the forming and quenching furnaces for the purposes of insuring perfect control of temperature and time element. Brown automatic control is a device through which the proper proportions of oil and air are thermostatically regulated in being fed to the furnace, thus keeping the furnace at a pre-determined temperature. The plates when placed in the furnaces are arranged in an open position on racks spaced 2 in. apart to insure uniform heating.

Automatic control is applied to the tempering furnace and the plates after hardening are placed in plate trays with perforated bottoms arranged in rows 2 in. apart for uniform spacing, to insure complete and immediate contact with the solution. A siren is used to attract the attention of the operator when leaves have been in Draw Temp a sufficient length of time at the proper temperature.

The quenching tanks are located close to the furnace doors and the plates are handled with special tongs speedily into the quenching bath to prevent a drop in temperature, a most important detail. The springs remain in the bath until about 300 deg. F. temperature. When they are removed after tempering in the Draw Temp they are dipped in a water tank which cleans the plates.

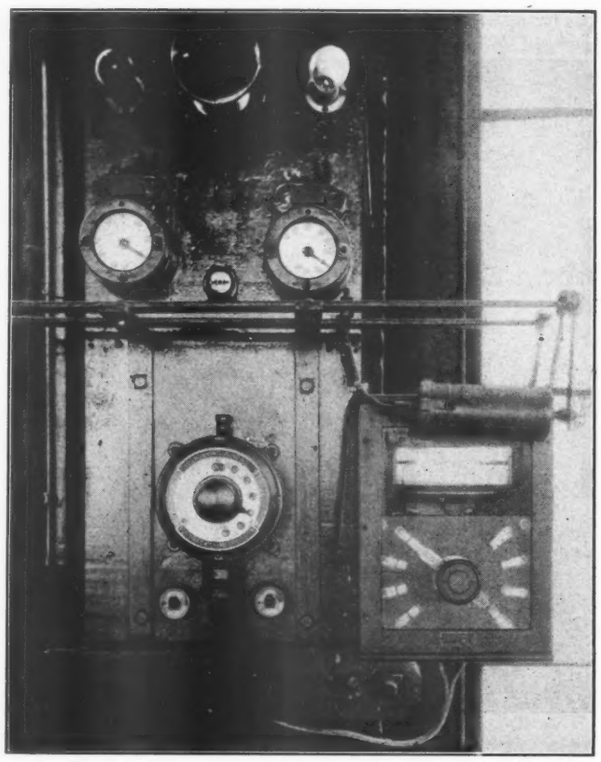
After being removed from the bath and allowed to cool they are banded, placed in a bath of oil to thoroughly lubricate the plates and protect against rusting, after which they are tested and if failures occur, springs are again returned to have the bands removed and the procedure repeated.

One of the later steps in the process of the development of this plant was the installation of a furnace for heating the spring bands before stripping, it having been discovered that in cold stripping the nibs on the spring plates were damaged and resulted in failures. Stripping of heated bands prevents this damage.

In conclusion it was found necessary to develop maximum physical possibilities of the steel used. This includes:

1st—The temperature for forming so as to prevent excessive grain growth, and subsequent cooling to 300 deg. F. in order to eliminate this difficulty completely.

2nd—The temperature for quenching in order that the steel may be quenched at the temperature which would produce the finest grain and the maximum tensile strength, eliminating soft spots and a partially pearl-

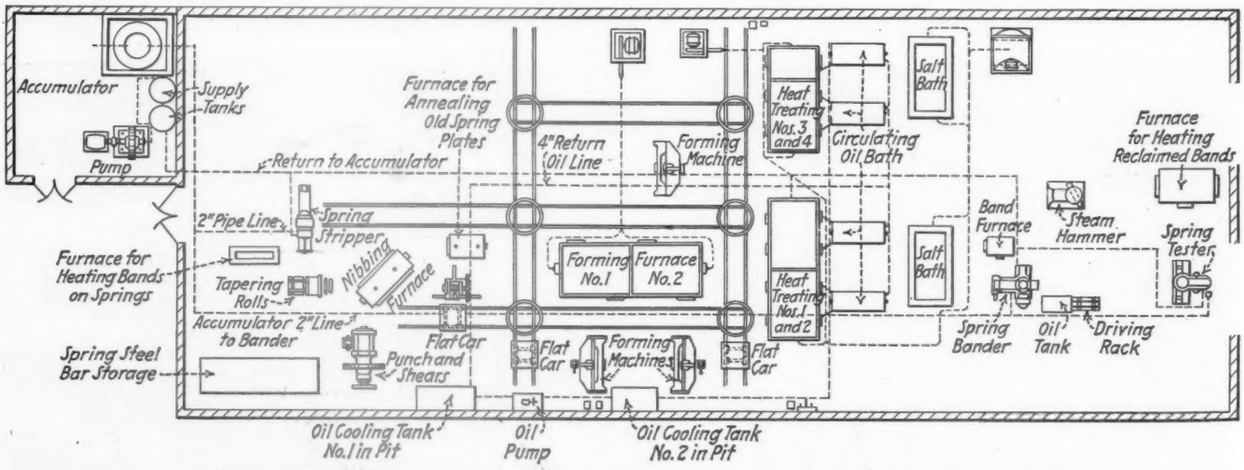


Siren signal used with draw temp bath

itic condition. To do this it is necessary that the quenching medium be one which will produce this maximum hardness at various temperatures continuously, regardless of its age. In other words the oil must not break down at any time in 10 years of operation.

3rd—Having obtained this initial hardness, the degree of ductility can be controlled by the temperature of the drawing bath. Had the initial hardness not existed, it would have been impossible to produce a uniform ductility.

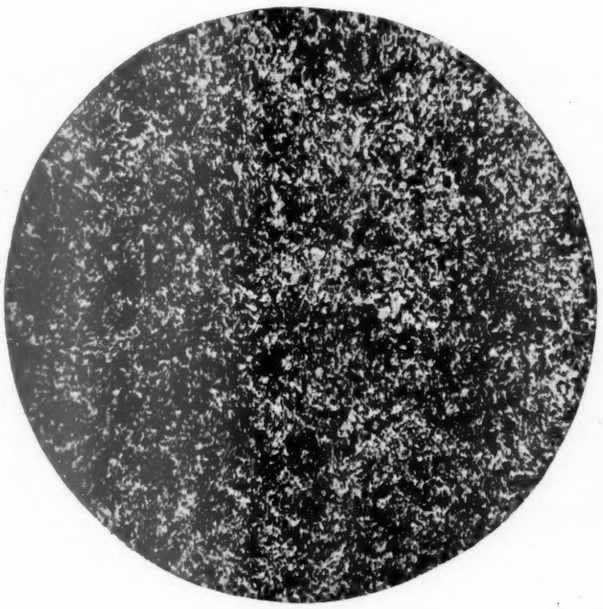
4th—The springs must be free of surface defects as cracks develop therefrom. They must be free from



Layout of the Mt. Clare spring plant—The operation begins at the stripper at the left

scale formed by surface oxidation. This scale cuts down the thickness and materially reduces the life of the spring.

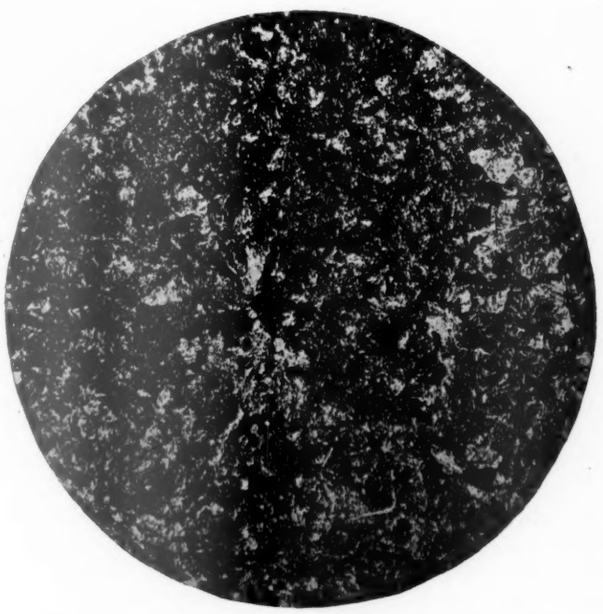
5th—The draw-back temperature must be positively controlled within an extremely close range, and the



Photomicrograph of steel treated at 1,500 deg. F. and showing desirable grain structure

drop in temperature from the furnace to the quenching tanks must be kept within 50 deg. F.

6th—It is important to burn the oil with a large vol-



Photomicrograph of steel treated at 1,700 deg. F. and showing coarse structure due to too high temperature

ume of air at low pressure in operating all furnaces —forming, quenching and drawing.

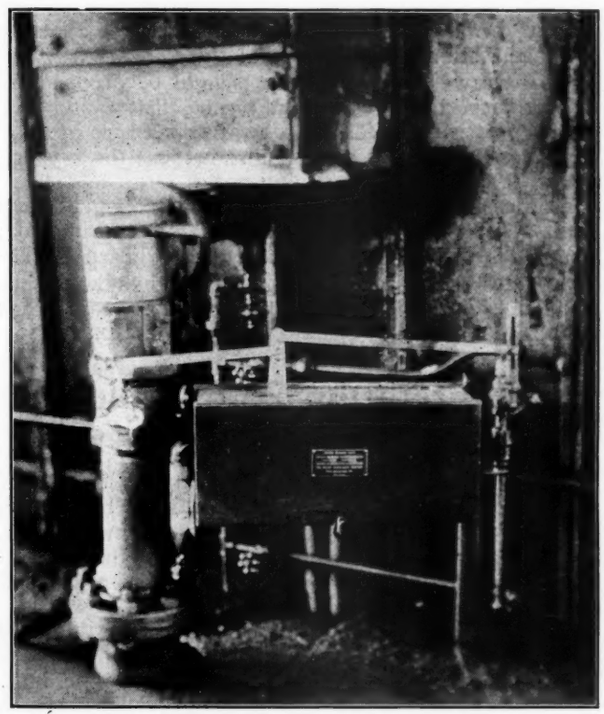
As a result of the above research the following instructions concerning the manufacture of elliptic and semi-elliptic springs were installed:

1—Spring leaves are to be heated in a pyrometer controlled fitter furnace at 1,750 deg. F., which temperature should not be exceeded.

2—Heated leaves are to be formed to contour on a forming machine, then placed on a truck and allowed to cool until black.

3—Place the entire spring in a pyrometer controlled tempering furnace and heat uniformly to 1,500 deg. F., holding this temperature for 30 minutes. It is important that spring leaves do not touch one another—leave a space of about 2 in. between each leaf, when standing in the furnace on edge. (See drawings.)

4—Remove the spring leaves from the tempering furnace as rapidly as possible and submerge instantly in the circulating oil bath, allowing them to remain therein until cool enough to prevent flashing of oil when the leaves are held on the surface of the bath; the oil in



The Brown automatic furnace control

the bath should not exceed 180 deg. F. (See drawing of oil tank.)

5—Spring leaves of the entire spring when removed from the oil bath should be placed in a perforated pan having separators to prevent touching one another; the pan and springs to be immersed in a salt bath, pyrometer controlled to 810 deg. F., remaining therein 20 minutes for temper drawback; remove springs from the salt bath and plunge momentarily in a water vat to remove chemicals; remove and allow to cool in air. (See drawing of salt bath.)

6—Material, at all steps of the operations while hot, should not be exposed to rain, snow or cold draughts. Pyrometers should be checked at frequent intervals to insure steel being heated to proper temperatures at all times.

7—After springs are cooled, place them in a banding machine and band; then remove and immerse in oil for lubrication and prevention of corrosion.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

Freight car maintenance

WORCESTER, MASS.

TO THE EDITOR:

All safety straps for securing brake rigging on freight cars should be suspended from the top of the spring planks and not from below. The peril of loose nuts or nuts missing is too great, allowing the safety strap to drop down en route, causing serious trouble on the road.

I also agree with the writer of the article entitled "What can be done about draft gears," which appeared on page 289 in the May issue of the *Railway Mechanical Engineer*, that draft gears should be dropped for proper inspection. The most trouble that I find with draft gears is short followers on the rivet type of yoke. The crosskey yoke is more secure because the key prevents the coupler from pulling out.

Is there any definite ruling as to how far sill steps shall be from the ends on tanks cars requiring four handholds on the side of the running boards? The rule states that the outer edge of the handhold shall not be more than 12 in. from the end of the car. How about the sill steps?

W. BURNHAM

Interpretation 25 of Rule 17

NEW HAVEN, CONN.

TO THE EDITOR:

J. B. Searles' question in the February, 1928, issue of the *Railway Mechanical Engineer* on Type D couplers having a 6-in. by 8-in. shank with a non-standard butt, is a fair one and is deserving of a ruling by the Arbitration Committee. This same question has been asked many times before and with many different answers.

The most logical way to make repairs in this case would be to apply an A.R.A. standard 6-in. by 8-in. shank Type D coupler or 5-in. by 7-in. shank with 9⅛-in. butt. If the former method is used, it would be necessary to make extensive alterations to the car before making such a substitution. Would you burn holes in the draft arms or sills to apply the cross-key? If you did, you certainly would be impairing the strength of the car. You could not apply a yoke with a vertical key attachment because the A.R.A. standard 6-in. by 8-in. shank coupler has no slot for the key. If the car were equipped with draft arms, you might remove them and apply draft arms with keyways and apply a cast steel yoke.

However, in either case you would be impairing the original construction of the car. Interpretation 25 to Rule 17 has been cited by many men as their authority to make the above-mentioned substitution without considering it as wrong repairs. A board ruling on the above-mentioned interpretation would be that you cannot make a radical change to any draft rigging without impairing the strength of the car. Regardless of what substitution you choose to make, if a car comes into your shop with a defective Type D coupler with 6-in. by 8-in. shank and 9⅛-in. butt with a riveted yoke, you are not going to change the entire draft rigging on that end of the car, whether or not the car is loaded.

Rule 17, Section C, has no bearing on this question at all as this paragraph does not make any provision for the non-A.R.A. Type D coupler. The entire question is settled by Section A of Rule 17.

All type D couplers are made to the same specifications, therefore, there is no question as to the difference of material. The difference in the weight of the Type D 6-in. by 8-in. shank, 9⅛-in. butt, and the A.R.A. standard shank, 9⅛-in. butt, is approximately 25 lb. This would not impair the strength of the car.

The tensile strength for both couplers is the same. The present A.R.A. standard 5-in. by 7-in. shank, 9⅛-in. butt coupler, is the heaviest standard coupler made. The lateral or vertical motion is not decreased and no part of the original construction of the car need be changed except the coupler.

In all probability, Mr. Searles would say that you must apply an A.R.A. standard 5-in. by 7-in. shank, 9⅛-in. butt coupler, unless you wish to make wrong repairs. I assume that the coupler that Mr. Searles refers to is the Type D, 6-in. by 8-in. shank, 9⅛-in. butt, and not the 9½-in. butt.

JAMES MCDONNELL

An antique tool still survives

CHICAGO,

TO THE EDITOR:

The picture at the bottom of page 272 in the May issue of the *Railway Mechanical Engineer* brings back to me many pleasant memories of the bygone days of my apprenticeship, at which time a device of this description might have been of considerable interest.

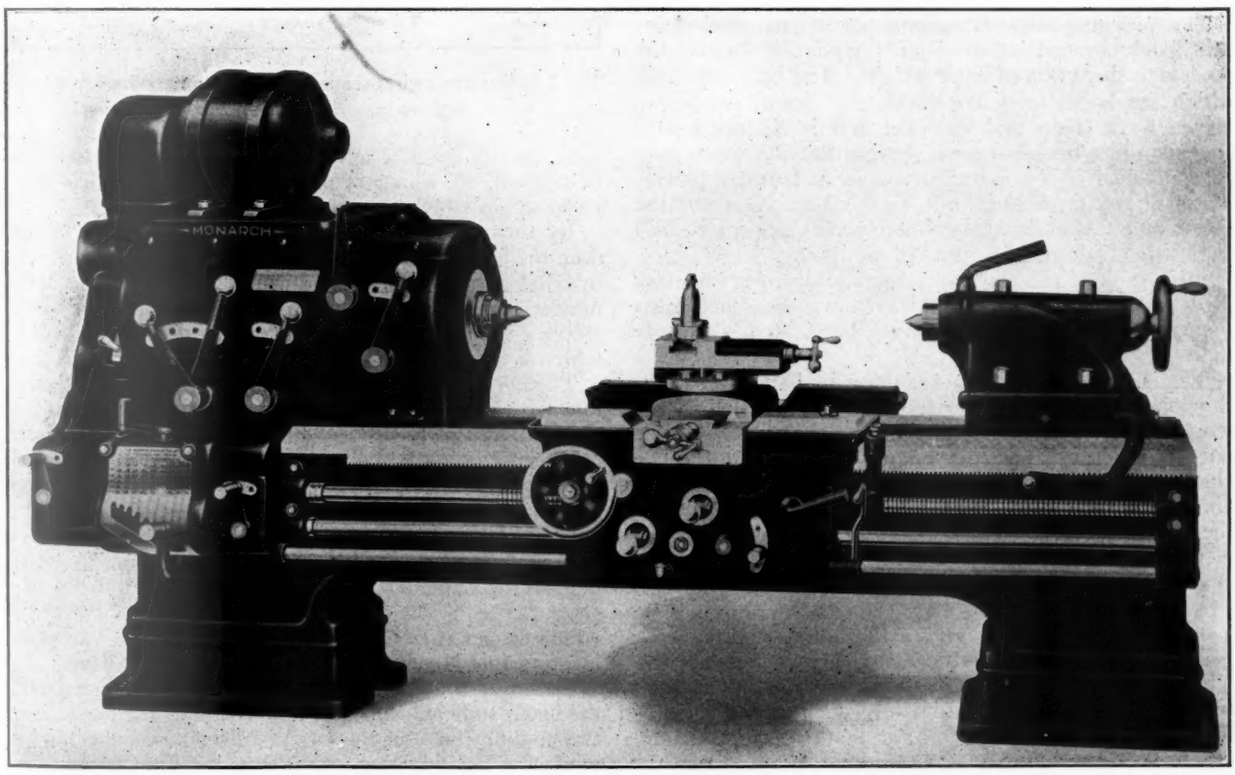
Is it possible that such means for sharpening tools are still existent in railway shops today or is this stone being used for another purpose? Regarding the soldering of the pet cock, is there not great danger of it being broken off while carrying the pail around the shop when having it filled? Does it not appear to be set up unnecessarily high? Is it not quite some lift to stand on the exposed part of the frame and place the pail in this "simple yet effective arrangement"? I presume the youngest cub-machinist keeps the pail filled.

Taking another look at this "simple yet effective arrangement", is there any arrangement for spreading the water over the full width of the stone, or does it only drip from the single opening of the small pet cock? In my time, several workmen used to grind at the same time. As I recall it, fifty years ago we had a tee made of ½-in. pipe containing several ⅛-in. holes so that the water reached the full width of the stone. This was also adjustable to the varying height or diameter of the stone, which, when first installed, was 60 in. in diameter and removed when it wore down to 24 in. I notice that the old loose wooden grinding rest is still in use. By the way, I recall that the ⅛-in. holes in the pipe were drilled with flat-forged drills, no twist drills being available at that period. The safety movement does not appear to be functioning in the picture; see the unprotected belt and pulleys.

"AN OBSERVER"

Monarch heavy duty lathe

THE Monarch Machine Tool Company, Sidney, Ohio, has recently placed on the market an improved design of its 30-in. helical gear, heavy duty engine lathe, in which all headstock bearings, including the spindle and all quick-change gear box bearings, are Timken tapered roller bearings. The swing of this lathe over the bed is 31½ in. and the swing over the carriage is 22 in. The all-geared headstock contains 14 helical gears of high carbon alloy steel, heat treated and hardened. With these 14 gears there are 16 spindle speeds available, speed changes being made by double-jaw clutches sliding on splined shafts actuated by means of four levers located on the front of the headstock. The speed change arrangement is so designed as to eliminate the possibility of engaging conflicting gear ratios. These spindle and headstock shafts are mounted in Timken tapered roller bearings which tend to make possible maximum precision in production and to minimize the tendency to leave tool marks on the work. The headstock oiling system is of the splash type. A special design multiple disc driving clutch with a brake is so arranged as to be operated both from the headstock and from the apron. The apron is a complete box section with the apron gears running in an oil bath. The rack pinion is mounted on anti-friction bearings and special patented apron friction feed levers are provided. The motor is mounted on top of the headstock and a silent chain drive is used as standard equipment, with a



The Monarch 30-in. Model N heavy duty lathe—Sixteen spindle speeds—Spindle and shafts mounted in Timken roller bearings

Tex-rope or gear drive optional. The motor size recommended for ordinary service is 10 to 15 hp. The quick-change gear box permits the cutting of a full range of threads from ¾ to 46 threads per inch. The spindle speed range with the driving pulley running at 500 r.p.m. is from 6 to 303 r.p.m.

A gasoline industrial tractor with a 10-ft. boom

AN industrial tractor on which is mounted a swinging 10-ft. boom, has recently been placed on the market by Frederic H. Poor, Inc., 50 Church street, New York. The unit moves from place to place under its own motive power, and the power for lifting and swinging the loads is derived through the power take-off from the same source; i. e., the tractor engine.

In designing the Loadmaster swing crane thorough consideration has been given to providing stability and sturdiness in a movable unit. To this end, specially weighted wheels are employed at both the rear and front to counterbalance the loads in suspension from the boom; and broad tires on these wheels sustain the loads without undue tire loading.

The frame, upon which the mast is located, consists of a fabricated plate and channel structure secured at the rear to the axle-housing of the tractor and suspended at the front in such a way as to compensate for irregularities in the floor or road-bed over which the machine travels.

The hoisting drum is directly connected to a self-locking worm gear and is operated from the power take-off through a clutch and bevel pinions by a control lever within easy reach of the driver. When the drum is not in motion, the self-locking worm gear holds the load in suspension on the boom without the use of a friction brake.

The swinging boom is constructed of two steel channels firmly braced together and equipped with the necessary sheaves and hook weight. The bull wheel, by which the boom is swung about the mast, is power driven by a chain and sprocket and is equipped with an expanding brake of such design that the boom may be controlled in its swing, or, when not under power, be set in any fixed position. The full swing-arc of the boom under load is approximately 240 deg.; i. e., 120 deg. either side of the forward position.

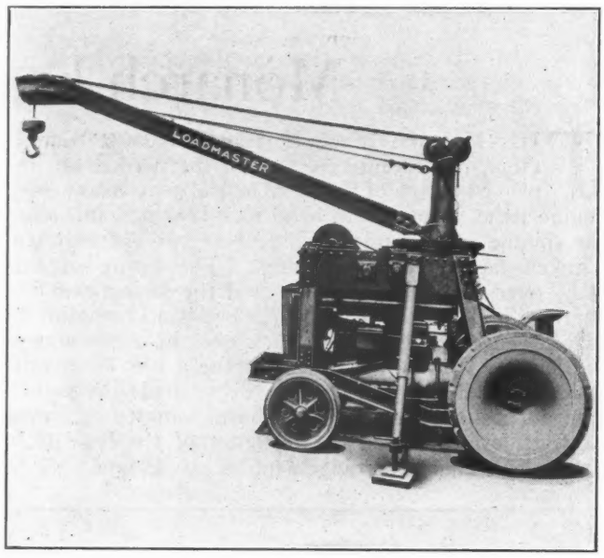
Adjustable telescoping outriggers, allowing heavier loads to be swung over the sides, can be furnished upon request. These outriggers may be folded alongside the machine when not in use.

The engine is started by cranking by hand. The machine is then driven under its own power to wherever work is to be performed, the driving gear-shift lever is put into neutral and the engine left running. The clutch is then pushed out by the foot of the operator and the power take off shift lever engaged; the clutch then is released.

This applies the tractor's power through a roller chain to the main jack shaft. On this shaft is mounted a double-disc multi-plate clutch surrounded by a nest of three bevel gears, the middle gear being permanently attached to the worm of a worm gear unit. The worm wheel or gear is mounted on a shaft on which is also mounted the hoisting drum. To raise or lower the load, the clutch lever is thrown in the desired direction; to stop the motion of the drum the clutch is put into neutral.

The worm-gear unit is of the self-locking type. Therefore, no ordinary friction brake is necessary, and positive braking, eliminating the human equasion, is thus assured.

The boom swing mechanism consists of roller chains and sprockets to reduce the speed of the jack shaft to a suitable speed for the swing shaft. On this shaft is a nest of three bevel gears inside of which is a positive



The Loadmaster swing-crane tractor is equipped with a 10-ft. boom that swings through an arc of 240 deg.

pin-type clutch. The middle gears are attached to a vertical shaft on which is mounted a sprocket driving a roller chain which surrounds the bull-wheel.

By throwing the swinger clutch in the desired direction, the boom is caused to swing to the right or left. An internal expanding brake is provided so that the boom may be locked at any position in its swing and the swing stopped when necessary. It is operated by a lever to which is attached a cam which is adjustable for wear.

The boom is supported by a holding line made of flexible wire rope. The rope is passed around a sheave at the end of the boom and made fast to the mast; the other end is made fast to a cast-steel drum which is mounted on a shaft. This drum is held in any desired position by a pawl and ratchet.

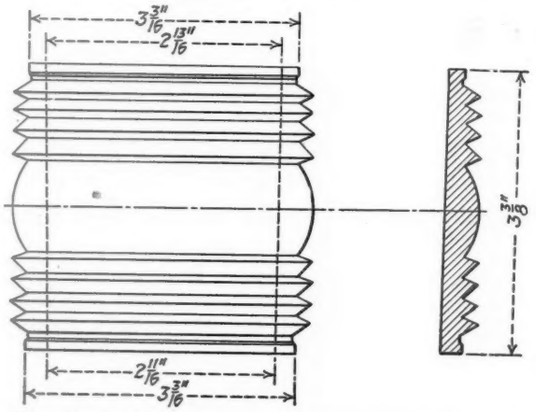
To raise the boom to a new position, the load hook is brought into contact with the end of the boom by hoisting the load line and continuing to raise as much as desired. The holding drum is operated by a coil spring which causes it to wind up the holding line. When the hoisting line is released, the pawl holds the drum.

To lower the boom, the hook is again contacted with the boom sufficient to relieve the strain of the boom from the holding line and the pawl is disengaged and held so while the hoisting line is lowered. The boom then lowers as fast as the hoisting line is run out and when at the desired position, the pawl is allowed to engage and the boom comes to rest.

With the full 10-ft. side swing and without outriggers, the crane has a lifting capacity of 1,000 lb., and with full forward swing, 2,400 lb. Raised to an 8-ft. outreach, the capacity is 1,250 lb. over the side and 2,400 lb. forward. Fully raised, with an outreach of 5 ft. 6 in., the capacity is 1,800 lb., over the side and 3,000 lb. forward.

A blue fresnel for the car repairman's lantern

FOR many years, a lantern with a blue globe hung on the end of a train, has been the only night protection the repair men have had when working under cars. Blue is a poor carrying color and many of the globes in service cannot be seen 400 ft. on a clear night. To improve this condition, the Kopp Glass, Inc., Swissvale, Pa., has designed a blue fresnel to take the place of a globe in the kerosene lantern which, instead of showing a flame ½ in. to ¾ in. in height, magnifies it to about 3 in. Instead of a visibility limited to 400 ft. as with some of the darker globes, this fresnel displays a good color indication from 1,500 to 1,800 ft.

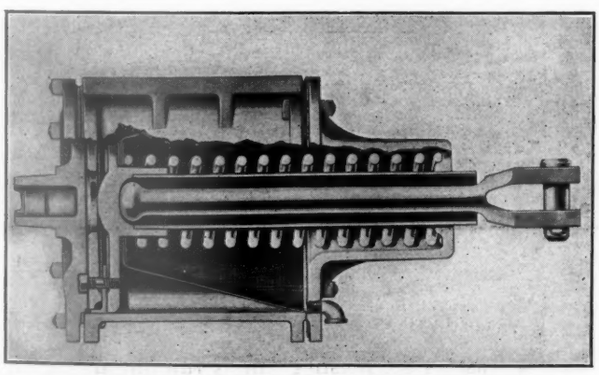


The Kopp blue fresnel can be seen from a distance of 1,500 to 1,800 ft.

Brake cylinder protector

THE Westinghouse Air Brake Company, Wilmerding, Pa., has recently placed on the market a brake cylinder protector which, as its name indicates, is designed to prevent dirt and water, which may enter at the non-pressure side of the piston, from reaching the cylinder walls and packing, thus increasing the life of packing cups and reducing leakage.

The protector consists of a conical-shaped impregnated canvas structure, so devised that at one end it is clamped between the cylinder body and the non-pressure head where it functions as a gasket, while at the other end it is held in position against the piston by the release spring. Any dirt or water entering the cylinder is trapped by the protector. The water is discharged through a drain opening provided in the non-pressure head. The protector is flexible and collapses as the brake is applied.



The brake cylinder protector prevents dirt and water from reaching the cylinder walls and packing

IRVING CONTINUOUS FLOOR ARMORING.—The Irving Iron Works Company, Long Island City, N. Y., presents in Bulletin K a well-illustrated description of Irving continuous floor armoring designed to withstand the heavy traffic encountered in industrial plants. The sizes and types of armoring for various classes of service are given, also instructions for its proper installation.

PIPE THREADING EQUIPMENT.—The Oster 4-in. Power Boy (No. 414) and the Oster 4-in. cutter, two new products of the Oster Manufacturing Company, Cleveland, Ohio, are among the complete line of pipe threading equipment illustrated and described in the company's new catalogue, No. 36. The new 4-in. Power Boy will thread pipe from ½ in. to 4 in. and up to 12 in. by using an extension drive shaft. The new 4-in. cutter was designed particularly for use with the No. 414 Power Boy and cuts pipe cleanly and without the usual ragged burr.

PUTNAM SERVICE.—A comprehensive picture of the scope and magnitude of Putnam service as it is rendered in industrial and railroad fields through heavy duty machines and production tools, is given in the 32-page book, entitled "To Help You See Us as We See Ourselves," dedicated, on its ninety-second anniversary, to the founders of the Shaw-Crane-Putnam Machine Company, 100 East 42nd street, New York. The book is divided into two sections, the first section depicting the Putnam Works at Fitchburg, Mass., the types of machines manufactured, and several of the departments wherein the machines are assembled, tested, etc. The second section similarly illustrates the Shaw Crane Works at Muskegon, Mich.

* * *

Interior of a Delaware, Lackawanna & Western day coach equipped with rotating two-passenger seats

News of the Month

THE LOUISVILLE & NASHVILLE plans the construction at Mobile, Ala., of a 12-track yard with a turntable, 17-stall enginehouse, coaling station, cinder pits and similar engine terminal facilities and a combination boiler, blacksmith and machine shop adjoining the enginehouse. The yard will be located within the northern limits of Mobile immediately south of Three Mile creek.

Oil-burning engines on C. R. I. & P.

THE CHICAGO, ROCK ISLAND & PACIFIC plans to substitute oil-burning locomotives for coal-burning locomotives on more than 1,500 miles of lines in Kansas, Texas and Oklahoma, including the entire El Paso-Amarillo division, the conversion is to be completed by October 15 for both freight and passenger service. The conversion of this section of the road will give the Rock Island a total of 2,700 miles of lines on which oil will be used instead of coal, or approximately one-third of the entire system. Oil is now used on locomotives on the lines in Arkansas and Louisiana and on the main line between Caldwell, Kan., and Dallas, Tex.

Locomotives in need of repair decrease

LOCOMOTIVES in need of repair on the Class I railroads on June 1 totalled 8,421 or 14.1 per cent of the number on line, according to reports filed by the carriers with the Car Service Division. This was a decrease of 682 locomotives compared with the number in need of such repairs on May 15, at which time there were 9,103 or 15.2 per cent.

Locomotives in need of classified repairs on June 1 totalled 4,672 or 7.8 per cent, a decrease of 342 compared with May 15, while 3,749 or 6.3 per cent were in need of running repairs, a decrease of 340 compared with the number in need of such repairs on May 15. Class I railroads on June 1 had 7,161 serviceable locomotives in storage compared with 6,912 on May 15.

Third-class sleeping accommodations in England

THE LONDON, MIDLAND & SCOTTISH, the London & North Eastern and the Great Western propose to provide sleeping accommodations for third-class passengers experimentally, according to reports to the United States Department of Commerce. The railway companies at present are not prepared to say more than that designs and estimates have been prepared to adapt a number of third-class corridor cars and to put these in service shortly.

The adaptation of cars to meet the demand for third-class sleepers will help to remove weight behind the engine. A first-class sleeping car is heavily weighted to make it run smoothly, the weight with a full car averaging over three tons per passenger. The ordinary weight per passenger is about 1,200 lb. The adaptation of third-class compartments will, however, cut down the accommodation of those compartments by one-half, and if this necessitates the use of additional cars and an extra locomotive, or dividing some of the long haul trains into two sections, it is feared that it will result in a loss to the companies.

Laboratory tests of railroad bearing bronzes inadequate

NO ONE of the selected laboratory tests, consisting of wear, tension, impact and pounding, can by itself, be expected to yield information which is adequate for general comparisons of the various railroad bearing bronzes now in use, a study just made by The Bureau of Standards, Department of Commerce, reveals. According to H. J. French, who was in charge of the work, the bronzes fall into certain general classes, as regards their wearing and mechanical properties, and each group shows superiority for certain types of service.

This work was undertaken by the bureau in an effort to secure data which would be necessary if any attempt was made to simplify these specifications and, also because it appeared highly desirable to study the properties of the various railroad bearing bronzes now in use. The study covered wear and mechanical properties at various temperatures.

There are almost as many specifications for railroad bearing bronzes as there are railroads. As far as can be judged from laboratory tests, existing specifications can be simplified, Mr. French states.

Meetings and Conventions

Car Department Officers Association to meet in St. Louis

THE RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION, which was formerly the Chief Interchange Car Inspectors' and Car Foremen's Association, is holding its annual convention this year at the Statler Hotel, St. Louis, Mo., September 11 to 13, inclusive. This is the first time for many years that this association has held its annual convention in any city other than Chicago. The program which is now being arranged includes addresses by Col. B. W. Dunn, chief inspector, Bureau of Explosives; Henry Miller, president, Terminal Railroad Association of St. Louis, and R. H. Aishton, president, American Railway Association.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York.

AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting Windsor hotel, Montreal, September 11-13.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Annual convention Hotel Sherman, Chicago, September 12-14.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, October 23-26, Hotel Sherman, Chicago.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST LOUIS.—A. J. Walsh, 5874 Plymouth Apt. 18, St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—(See Railway Car Department Officers' Association.)

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting Hotel Sherman, Chicago, August 21-22, 1928.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn. Annual convention Hotel Sherman, Chicago, September 18-21, 1928.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago. Convention September 11-13, Hotel Statler, St. Louis, Mo.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205 Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—E. H. Weigman, master car builder, the Kansas City Southern, Pittsburg, Kan. Annual meeting August 4, 5 and 6 at Galveston, Tex.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month. Terminal Hotel bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio. Annual meeting Hotel Sherman, Chicago, September 25 to 28 inclusive.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

* * *

Photo by H. Armstrong Roberts

Supply Trade Notes

JAMES CLEARY has been appointed general sales manager of Combustion Engineering Corporation, New York.

W. J. STANTON, who has been associated with the Ohio Brass Company for the past eight years, has resigned to open a manufacturers' agency at 120 Broadway, New York.

CHARLES C. ELY, president and treasurer of the Trimont Manufacturing Company, Providence, R. I., died on June 6.

FREDERICK HUNTINGTON PARKE, general engineer of the Westinghouse Air Brake Company, Wilmerding, Pa., died suddenly on June 16th.

THE CHICAGO SALES OFFICE of the Joseph Dixon Crucible Company is now located at 2003 Builders' building, Wacker Drive and LaSalle street.

CHARLES H. JACKSON has been appointed general sales engineer and Ernest Szekely, chief engineer of the Bayley Blower Company, Milwaukee, Wis.

THE ZAPON COMPANY, manufacturing chemists, Stamford, Conn., owned by Richards & Co., Inc., has acquired The Duratex Corporation of Newark, N. J.

R. J. MCCOMB, western manager of the Q and C Company at Chicago, has resigned to become sales manager of the Woodings Forge & Tool Company, Verona, Pa.

C. O. HOLMES and W. T. Corbett have been appointed vice-presidents of the United States Steel Products Company, export subsidiary of the United States Steel Corporation.

CHARLES A. TERRY, vice-president of the Westinghouse Electric & Manufacturing Co., has been elected to the directorship of that company left vacant by the death of General Guy E. Tripp.

T. H. SCAFFE has been appointed district manager of the Detroit branch of the United States Electrical Tool Company, Cincinnati, Ohio, and R. N. Brayer has been added to the personnel at Detroit.

GEORGE E. CORNWALL has been appointed supervisor of the railway sales division of the Heywood-Wakefield Company. Mr. Cornwall will have his headquarters at the executive offices of the company, Boston, Mass.

WILLIAM M. DU PONT, of Wilmington, Del., has been elected chairman of the executive committee of the Miller Train Control Corporation, succeeding his father, the late William M. du Pont.

THE NORTHERN ENGINEERING WORKS, Detroit, Mich., has appointed the Interstate Supply Company, Commercial Trust building, Philadelphia, Pa., its district factory representative for that district.

THE CURTIN-HOWE CORPORATION, wood preserving engineers, New York City, announce the appointment of Kenneth M. Bailey as technical sales representative, with office at 515 N. O. Bank building, New Orleans, La.

THE GUNITE CORPORATION, Rockford, Ill., has placed A. N. Willsie in charge of railway sales. Mr. Willsie for many years represented the Locomotive Stoker Company as western sales manager.

THE FULTON IRON WORKS, St. Louis Mo., has bought the Foos Engine Company, Springfield, Ohio, makers of Diesel engines of from 60 to 300 hp., according to an announcement of Harry J. Steinbreder, president of the Fulton company. The Fulton company, which has been turning out the higher horsepower engines for some time, will now have a line of Diesel engines ranging from 60 to 2,000 hp.

Lord Dalziel of Wooler, chairman and managing director of the Pullman Car Company, Ltd., (England), and chairman of the board of directors of the managing committee of the International Sleeping Car Company, died on April 18, at his home in London, Eng.

A. N. Willsie, formerly western sales manager of the Locomotive Stoker Company, has been placed in charge of railway sales of the Gunite Corporation, Rockford, Ill., recently organized to handle the sales and distribution of Gunite, a graphitic steel.

The Pyle-National Company, Chicago, has opened the following offices: in the Little building, Boston, Mass., in charge of Carl S. Geis; in the Marine Bank Building, Houston, Tex., in charge of Alexander E. Johnson, and in the Oliver building, Pittsburgh, Pa., in charge of Thomas P. McGinnis.

J. V. Moore, formerly with the Simonds Saw & Steel Company, is now representing The Billings & Spencer Company, Hartford, Conn., in the states of Pennsylvania, Delaware and New Jersey. Mr. Moore's headquarters are at Huntingdon, Pa.

L. C. Bihler, traffic manager of the Carnegie Steel Company, Pittsburgh, Pa., has been appointed an assistant to president and general traffic manager; W. S. Guy, assistant traffic manager, has been appointed traffic manager; G. W. Seaman and C. W. Trust have been appointed assistant traffic managers.

The Roller-Smith Company, New York, announces recent sales organization changes involving the appointment of John A. Coleman, Houston, Tex., to handle the Texas territory and the assignment of H. T. Weeks, Denver, Colo., to a territory embracing Colorado, Utah, Wyoming and northern New Mexico.

The Standard Railway Equipment Company, the Union Metal Products Company, and the Railway Metal Products Company, have moved their offices from the Railway Exchange building, Chicago, to the Shell building, St. Louis, Mo. A. G. Bancroft is southwestern sales manager, and E. G. Fredell, service engineer, at St. Louis, Mo.

Edward E. Gold, president of the Gold Car Heating & Lighting Company since its organization, has been elected chairman of the board; Frank W. Dearborn connected with the company, was elected president to succeed Mr. Gold, and Franklin H. Smith of the sales department was elected assistant treasurer, all with headquarters at Brooklyn, N. Y.

B. Kuckuck who was active in the introduction of the Reuping process of timber preservation in this country a number of years ago and who has more recently been chief engineer of a large wood preserving company in Europe, has been appointed chief engineer of the Curtin-Howe Corporation, New York, promoters of a new wood preservative known as Zinc Meta Arsenite.

Henry Gardner, formerly consulting engineer with the Steamotor Company of Chicago, has become associated with The Comtor Company, Waltham, Mass., as vice-president in charge of sales. He will be engaged in introducing the "Comtor System." Mr. Gardner is a graduate of the Massachusetts Institute of Technology and for a number of years held the position of special mechanical engineer on the Baltimore & Ohio.

The Ohio Steel Foundary Company, Lima, Ohio, has given a contract to the H. K. Ferguson Company, Cleveland, for a foundry unit to cost with equipment, $75,000. Additional equipment for the manufacture of locomotive castings and other heavy steel products will be provided in the new building, which will be 53-ft. wide, 253-ft. long and 35-ft. high. A 10-ton bridge crane and a jib crane of the same size will be installed.

Hugh K. Christie has been appointed a special salesman in the railroad department of the Whiting Corporation, Harvey, Ill. He entered the employ of the Pere Marquette as a machinist in the Saginaw shops and later held the positions of air brake foreman, general locomotive foreman and air brake supervisor and instructor. For the past nine years he has specialized in railway shop training as an editor, magazine and textbook writer and educator.

The Isothermos Corporation of America has been formed to manufacture to American standards the "Isothermos" journal box, now in use on European, African and South American railroads. The Isothermos journal box has an automatic lubrication system. The executive offices of the American company are at 11 West 42nd street, New York. The officers and directors of the new corporation are: Hubert E. Rogers, president, Rogers & Whitaker, New York; A. DeBac, vice-president, chairman of the Societe Internationale Isothermos, Geneva, Switzerland; Dr. F. H. Hirschland, treasurer, president, Metal & Thermit Corporation, New York; Spier Whitaker, Rogers & Whitaker, New York; and Geo. Grandjean, director, de la Banque Francaise de l'Afrique, Paris, France.

George C. Scott, vice-president of the United States Steel Products Company, New York, has been elected president, succeeding E. P. Thomas, who recently assumed his new duties as vice-president in charge of commercial matters, of the United States Steel Corporation. Mr. Scott started work with the St. Louis Wire Mill Company, which was absorbed by the Consolidated Steel & Wire Company. He was then transferred to its Cleveland office in charge of exports to the Far East. This company was merged with the American Steel & Wire Company of Illinois in 1898, and Mr. Scott was then transferred to New York City where he was manager of the export department. On the formation of the United States Steel Products Company in 1903, he became a departmental manager in charge of sales in the Far East, Australia and South Africa, and since March, 1920, had served as vice-president.

George C. Scott

The Manning Abrasive Company, Inc., Troy, N. Y., and Herman Behr & Company, Inc., Brooklyn, N. Y., manufacturers of sandpaper and general coated abrasive products, have been consolidated under the name of the Behr-Manning Corporation. The factories in Brooklyn and in Troy will be continued in operation as heretofore.

Baldwin ceremonies at Eddystone

An elaborate program commemorating the removal of the plant of the Baldwin Locomotive Works from Broad and Spring Garden streets in Philadelphia, to Eddystone, Pa., was held at Eddystone on June 28. A large grandstand was erected adjacent to the new eight-story administration building and was filled with employees, and a great number of railroad, railway supply and public representatives from all parts of the country. Special trains for the guests were operated from New York, Philadelphia, and from Atlantic City, many of the members of the Mechanical Division of the American Railway Association coming from the latter point.

Samuel M. Vauclain, president of the company, presided at the celebration, and in his address emphasized the determination of the company to secure business from foreign countries. His company will continue to pay high wages, but will successfully compete with countries where low wages are paid, because of greater plant operating efficiency. Other addresses were made by James J. Davis, Secretary of Labor, and by Judge Alfred Dutton MacDade of the Delaware County Courts.

Trade Publications

HAND-POWER CRANES.—Bulletin No. 185 of the Whiting Corporation, Harvey, Ill., describes a hand-power crane equipped with Hyatt roller bearings and gives bridge clearance and trolley clearance dimensions.

CHAIN HOISTS.—The outstanding features and advantages of the red, roller bearing hoist are pointed out in a cut away view of the Union hoist shown on the circular issued by the Union Manufacturing Company, New Britain, Conn.

PIPE THREADING MACHINERY.—Pipe threading and cutting machines, pipe and nipple threading machines and the Model Y chaser grinder are described and illustrated in catalogue No. 31 of the Landis Machine Company, Inc., Waynesboro, Pa.

AUTOMATIC CONTROL.—"Speeding Up Production with Automatic Control" is the title of a 20-page bulletin, No. 110, issued by the Monitor Controller Company, Baltimore, Md. A few specific applications of Monitor controllers to machine tools are discussed.

FILING SYSTEM.—The Globe-Wernicke Company, Cincinnati, Ohio, has published a 24-page booklet on a system for the filing and indexing of maps, plans, drawings and similarly large sheets. Installations and various types of filing units are shown in the booklet.

"OXYACETYLENE WELDING IN THE FOUNDRY."—This is the title of a paper recently read before the Welding Conference, University of Wisconsin, Madison, Wis., and reprinted in an 11-page brochure by the Air Reduction Sales Company, 342 Madison avenue, New York.

UNION CHUCKS.—Manually operated chucks for all classes of work and every type of machine tool are listed in catalogue No. 60 of the Union Manufacturing Company, New Britain, Conn. This catalogue is a small size standard book adopted to meet the requirements of the majority of purchasing agents.

HEATERS.—"The cold facts on a hot subject" contained in the folder of the Bayley Blower Company, 730 Greenbush street, Milwaukee, Wis., are descriptive of Chinookfin heaters which can be installed as a general heating system in the machine shop, woodworking plant, storage building, or other types of buildings in which steam is available for heating purposes.

GRAPHITE STEEL.—A new high carbon steel, having graphite carbon uniformly distributed by a precipitation process throughout the castings, is described in a 22-page brochure issued by the Gunite Corporation, Rockford, Ill. Some applications of this new steel, known as Gunite, to a wide range of products are described in the booklet.

ISOTHERMOS JOURNAL BOX.—The Isothermos Corporation of America, 11 West Forty-second street,, New York, has bound together in booklet form a number of bulletins illustrating foreign locomotives and cars equipped with Isothermos journal boxes. A description of the journal box is also included with these bulletins, and cross-sectional views show the details of its construction.

NILES TOOLS.—The 24-page booklet, entitled "On land—on water—in the air", issued by the Niles-Bement-Pond Company, 111 Broadway, New York, contains a brief history of the development of Niles tools step by step with American railroads, the automobile and aeroplane industries, and marine work. Various types of machine tools particularly adapted for the wide variety of work encountered in these fields are also illustrated and briefly described.

PIPE THREADING AND CUTTING-OFF MACHINES.—The Landis Machine Company, Waynesboro, Pa., describes in detail in catalogue No. 31 its complete line of pipe threading and cutting-off machines, pipe and nipple threading machines, and the Landis chaser grinder. The catalogue also contains tables concerning Briggs standard and Whitworth standard pipe thread specifications and a table of cutting speeds for the various diameters of pipe from 1 in. to 20 in., inclusive.

Personal Mention

General

RUSSELL G. HENLEY, who has been appointed superintendent of motive power on the Norfolk & Western at Roanoke, Va., was born at Edgemont, King and Queen County, Va., on May 17, 1884. He served a special apprenticeship with the Richmond Locomotive Works and entered the service of the Norfolk & Western on September 5, 1905. In December, 1908, he was appointed assistant enginehouse foreman at Bluefield, W. Va., and in June, 1911, he became night enginehouse foreman at Williamson. The following year he was made day enginehouse foreman. From December, 1915, to June, 1916, he served as foreman at East Radford, Va., being appointed general foreman on the latter date. He was advanced to the position of master mechanic of the Pocahontas division on February 15, 1918, and in November of the same year he was transferred to the Scioto division in the same capacity. He was appointed assistant to the superintendent of motive power at Roanoke on February 1, 1918, and served in that capacity until his recent promotion to superintendent of motive power.

Russell G. Henley

M. R. REED, master mechanic on the Pennsylvania at Fort Wayne, Ind., has been appointed superintendent of motive power of the Northern division, succeeding R. H. Flynn, transferred. Mr. Reed was born on June 26, 1883, at Newton, Ill. He was graduated from Rose Polytechnic Institute in June, 1905. Previous to his graduation he had served during the summer of 1904 as a laborer in the Terre Haute shops of the Pittsburgh, Cincinnati, Chicago & St. Louis, a subsidiary of the Pennsylvania. After his graduation he returned to the Terre Haute shops as a signal repairman. A few months later he resigned to become a special apprentice on the Union Pacific at Omaha, Neb. He returned to the Panhandle in September of the following year as a draftsman in the Terre Haute shops. In June, 1907, he was promoted to assistant foreman; in February, 1909, became chief draftsman; in April, 1917, transferred to the Northwest system of the Pennsylvania, Lines West, as a general car inspector, and in September, 1918, promoted to superintendent of car repairs. He was appointed master mechanic of the Eastern division in August, 1919 and when the administration of the Pennsylvania was re-organized in March, 1920, he was transferred to the Logansport division as master

M. R. Reed

mechanic. In April, 1925, he was appointed assistant general superintendent of motive power of the Northwestern region. Mr. Reed was appointed acting master mechanic of the Fort Wayne division, with headquarters at Fort Wayne, Ind., in July, 1926, and later in the same year was appointed master mechanic.

J. L. Cunningham, superintendent of motive power of the Western Pennsylvania division of the Pennsylvania, has been appointed assistant to the general superintendent of motive power of the Central region. He was born on September 28, 1874, at West Fairfield, Pa., and entered the service of the Pennsylvania on November 13, 1891, as an apprentice in the Altoona machine shop. He was made machinist on February 1, 1896, and in August of the same year resigned from the service of the Pennsylvania. In June, 1900, he returned to that road as machinist in the Altoona machine shop and the following month was transferred as inspector to the Philadelphia division. On March 1, 1901, he was transferred to the Pittsburgh division in the same capacity, and in December, 1902, was made foreman on the Bedford division. One year later he was appointed assistant master mechanic on the Philadelphia division. In January, 1904, he became general foreman, and in August, 1906, he was appointed assistant engineer of the Central division. He was promoted to master mechanic of the Maryland division on July 1, 1913, and three years later was transferred to the Philadelphia division in the same capacity. He held this position until June, 1917, when he became superintendent of motive power of the Western Pennsylvania division.

Master Mechanics and Road Foremen

K. T. Miller has been appointed assistant mechanical engineer of the Erie, with headquarters at Cleveland, Ohio, succeeding H. A. Boyer.

O. F. Hark, master mechanic of the Norfolk & Western with headquarters at Portsmouth, Ohio., has been appointed general master mechanic, with headquarters at Roanoke, Va.

J. L. Barry, master mechanic of the Norfolk & Western at Bluefield, W. Va., has been transferred to Roanoke, Va., succeeding O. F. Hark.

T. L. Brown, general foreman of the Norfolk & Western at Lambert Point, Va., has been appointed master mechanic with headquarters at Portsmouth, Va., succeeding J. L. Barry.

J. A. Sheedy, master mechanic on the Eastern division of the Pennsylvania, with headquarters at Canton, Ohio., has been transferred to Wilmington, Del.

D. K. Chase, master mechanic of the Buffalo division of the Pennsylvania, at Olean, N. Y., has been transferred to the Eastern division, with headquaters at Canton, Ohio, succeeding J. A. Sheedy.

J. E. Brower, master mechanic on the Central region of the Pennsylvania, with headquarters at Pittsburgh, Pa., has been transferred to Ft. Wayne, Ind., with jurisdiction over the Ft. Wayne, the Grand Rapids and the Logansport divisions.

Shop and Enginehouse

D. B. Wakefield, erecting shop foreman of the Missouri Pacific, has been appointed general foreman, with headquarters at Palestine, Tex.

A. M. Firebaugh, federal locomotive inspector, has been appointed night roundhouse foreman of the Missouri Pacific, with headquarters at Palestine, Tex.

H. A. Boyer, assistant mechanical engineer of the Erie at Cleveland, Ohio, has been appointed assistant shop superintendent, with headquarters at Hornell, N. Y.

Car Department

H. Keith has been appointed car foreman of the Canadian National, with headquarters at Vancouver, B. C.

William Batie has been appointed district foreman of the Union Pacific System, Oregon Short Line at Montpelier, Idaho, effective May 7, replacing W. H. Murray, deceased.

J. T. St. Clair, engineer of car construction of the Atchison, Topeka & Santa Fe, with headquarters at Chicago, resigned recently to become vice-president and general manager of mining properties in Halifax, N. S., in which he is interested.

Purchases and Stores

G. E. Bacheller has been appointed purchasing agent of the Intermountain, with headquarters located at Boise, Idaho.

G. D. Tombs has been appointed division storekeeper on the Illinois Central, with headquarters at Memphis, Tenn., succeeding A. E. Walters who has resigned.

Russell J. Stackhouse, general storekeeper of the Reading Company, at Reading, Pa., has retired under the pension regulations after 42 years of service with that road.

William H. Morris, assistant general storekeeper of the Reading, at Reading, Pa., succeeds R. J. Stackhouse as general storekeeper, with headquarters at the same city.

John Ball, who has been promoted to assistant general purchasing agent of the Chicago & North Western and the Chicago, St. Paul, Minneapolis & Omaha, with headquarters at Chicago, has spent his entire railway service with the North Western. He was born at Manchester, England, on November 23, 1873, and after receiving his early education in a private school in England he attended a business college at Clinton, Iowa. Mr. Ball entered railway service in April, 1902, as a stenographer on the North Western, being advanced to stenographer to the general purchasing agent three years later. In August, 1905, he was placed in charge of stationery and dining car supplies and in November, 1908, he was advanced to buyer of general supplies. Mr. Ball was promoted to assistant purchasing agent of the North Western on January 1, 1911, a position he held until his further promotion to assistant general purchasing agent of the North Western system.

John Ball

C. H. Dayton, has been appointed division storekeeper on the Michigan Central at West Detroit, Mich., succeeding F. V. Tenkonohy, resigned.

D. B. Rivers, district storekeeper of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Miles City, Mont., has been transferred to Minneapolis, Minn.

The jurisdiction of E. S. Shapland, division storekeeper of the Illinois Central at Waterloo, Iowa, has been extended to include all material and supplies of all departments on the Wisconsin division.

J. V. Anderson, assistant district storekeeper of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Minneapolis, has been promoted to district storekeeper at Miles City, Mont., replacing Mr. Rivers.

The jurisdiction of R. J. Gable, division storekeeper on the Illinois Central, with headquarters at Clinton, Ill., has been extended to include all material and supplies of all departments on the Indiana division, succeeding G. F. Ohden, who has been assigned to other duties. Mr. Gable will also have under his jurisdiction all material of all departments on the Illinois division previously handled by the Burnside (Ill.) general storehouse.